

# Independent Evaluation of Recent Flooding in New Hampshire

Second Public Meeting

March 18, 2008



**FEMA**



# Tonight's Participants

- David Knowles, FEMA
- Brent McCarthy, URS Team (Watershed Concepts)
- Ben Pope, URS Team (Watershed Concepts)
- Brad Newlin, URS Team (Watershed Concepts)



# Tonight's Meeting in Context

- Second of three public meetings (first was December 12<sup>th</sup>)
- Most “technical” of the three public meetings
- Focus is on how the systems work
- Final meeting will present recommendations
- Final meeting slated for the end of June



# Agenda

- Quick review from the First Public Meeting
- Similarities and differences between the May 2006 and April 2007 flood
- Operations at selected dams
- What happens next
- Questions



# The project team

- FEMA
- URS Corporation
- Watershed Concepts and Riverside Technology
- Independent Review Panel
- The project team is responsible to FEMA



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# Project Scope

The purpose of the project is to investigate the flooding in May of 2006 and April of 2007 with three goals in mind:

- Quantify the differences between the two events (and other major events) – one of the topics for tonight
- Establish the role of dam operations at selected dams by NHDES and other operators in the flooding – tonight's other topic
- Establish ways to mitigate future flooding, which could be structural and non-structural in nature – in progress

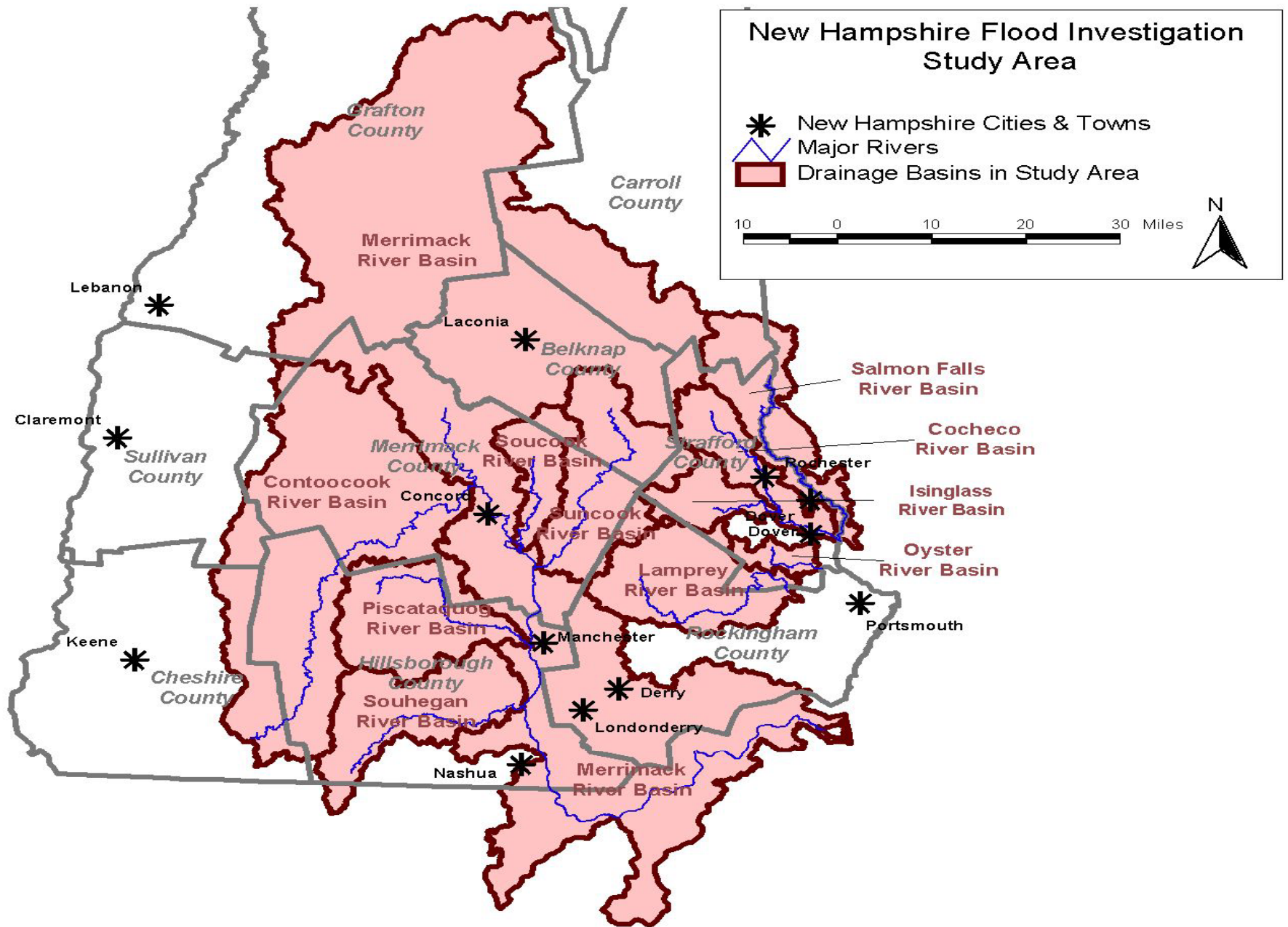


# Characteristics of the May 2006 and April 2007 Flood Events

- **May 2006 & April 2007**
- **100+ year events in 2 consecutive years**
- **Previous Major Floods**
- **Compare & Contrast**
  - Precipitation leading up to Storm
  - Stream Flow leading up to Storm
  - Event Precipitation Patterns
  - Event Discharge Magnitude and Recurrence Interval
  - Hydrograph Comparison



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Gage Station Number	Gage Station Name	Drainage Area	May 2006 Peak	May 2006 Runoff	May 2006 Recurrence Interval	April 2007 Peak	April 2007 Runoff	April 2007 Recurrence Interval	Maximum Peak of Record
01073000	Oyster River near Durham	12.1	873	7.8	10 - 50	1,320	6.1	100 - 500	Apr-07
01073500	Lamprey River near Newmarket	183	8,970	7.3	50 - 100	8,450	5.7	50 - 100	May-06
01073785	Winnicut River at Greenland near Portsmouth	14.1	1,450	--	> 500	1,030	--	100 - 500	May-06
01073822	Little River at Woodland Road near Hampton	6.12	774	--	> 500	n.a.	--	n.a.	May-06
01082000	Contoocook River at Peterborough	68.1	1,470	3.8	2 - 10	4,110	5.8	100 - 500	Apr-07
01085000	Contoocook R near Henniker	368	10,400	--	10 - 50	13,000	--	10 - 50	Sep-38
01086000	Warner River at Davisville	146	8,640	--	100 - 500	6,910	--	50 - 100	May-06
01089000	Soucook River near Concord	76.8	4,790	--	100 - 500	3,500	--	10 - 50	May-06
01089500	Suncook River at North Chichester	157	7,600	--	10 - 50	15,000	--	100 - 500	Apr-07
01091000	South Branch Piscataquoq River near Goffstown	104	7,180	--	100 - 500	9,700	--	> 500	Apr-07
01094000	Souhegan River at Merrimack	171	6,140	5.3	2 - 10	10,500	6.2	50 - 100	Mar-36



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# History of Major Floods in New Hampshire

- **March 1936**

- Snow melt combined with heavy rain; storm of record on Souhegan, Merrimack

- **September 1938**

- Hurricane rains; storm of record on Piscataquoq

- **March – April 1987**

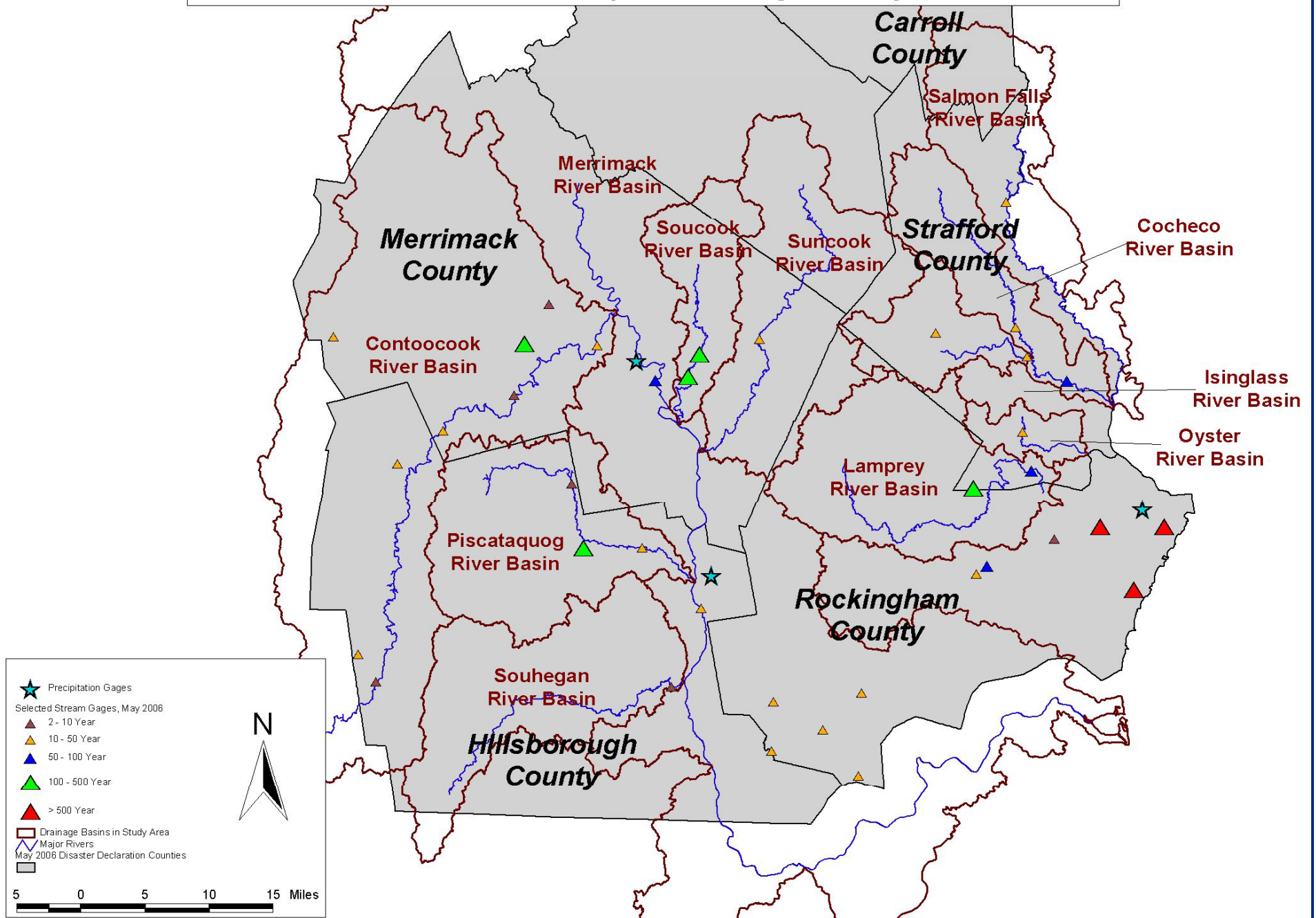
- Snowmelt combined with spring storms

- **October 1996**

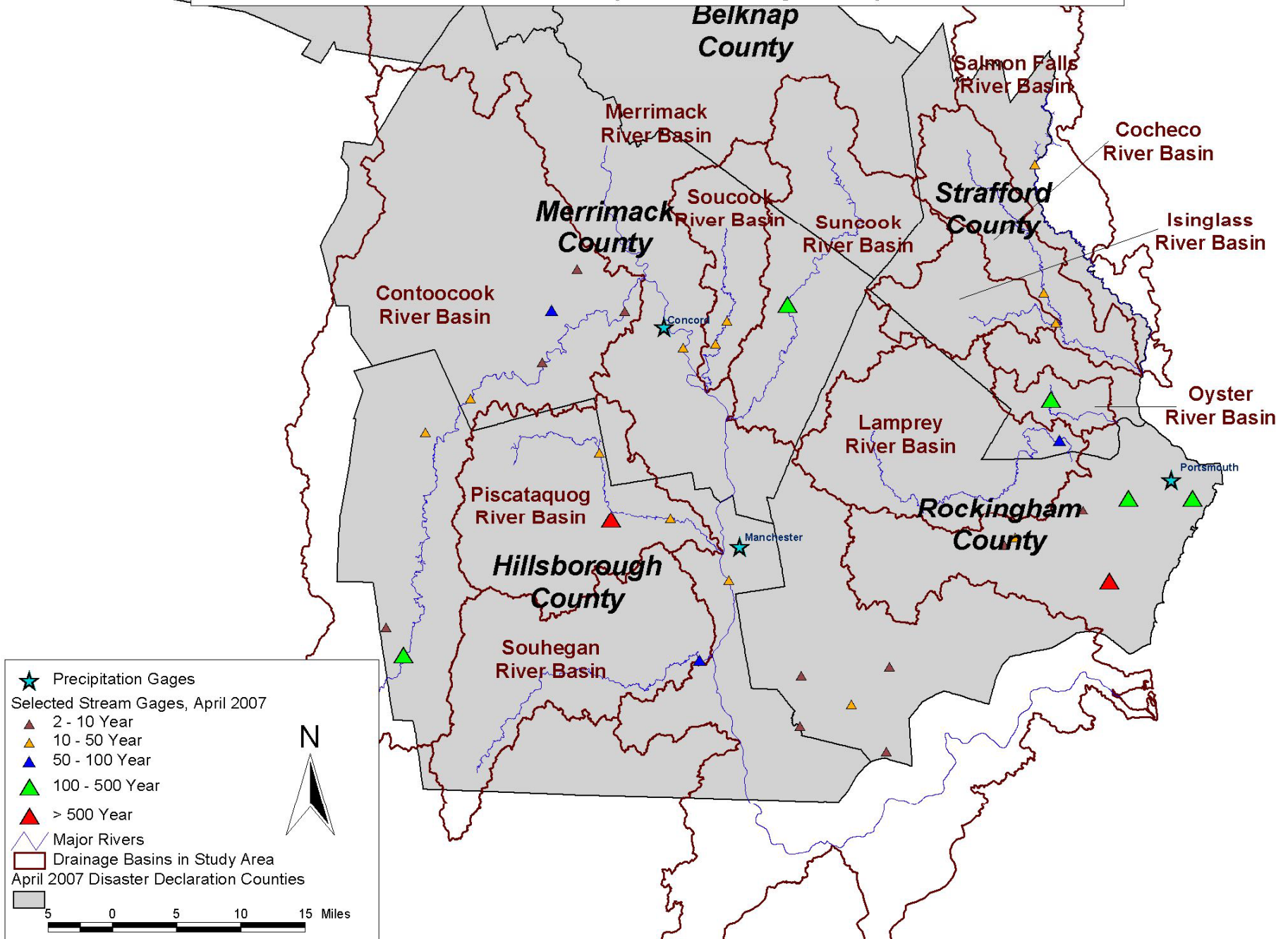
- Heavy fall rains; prior peak of record on several streams

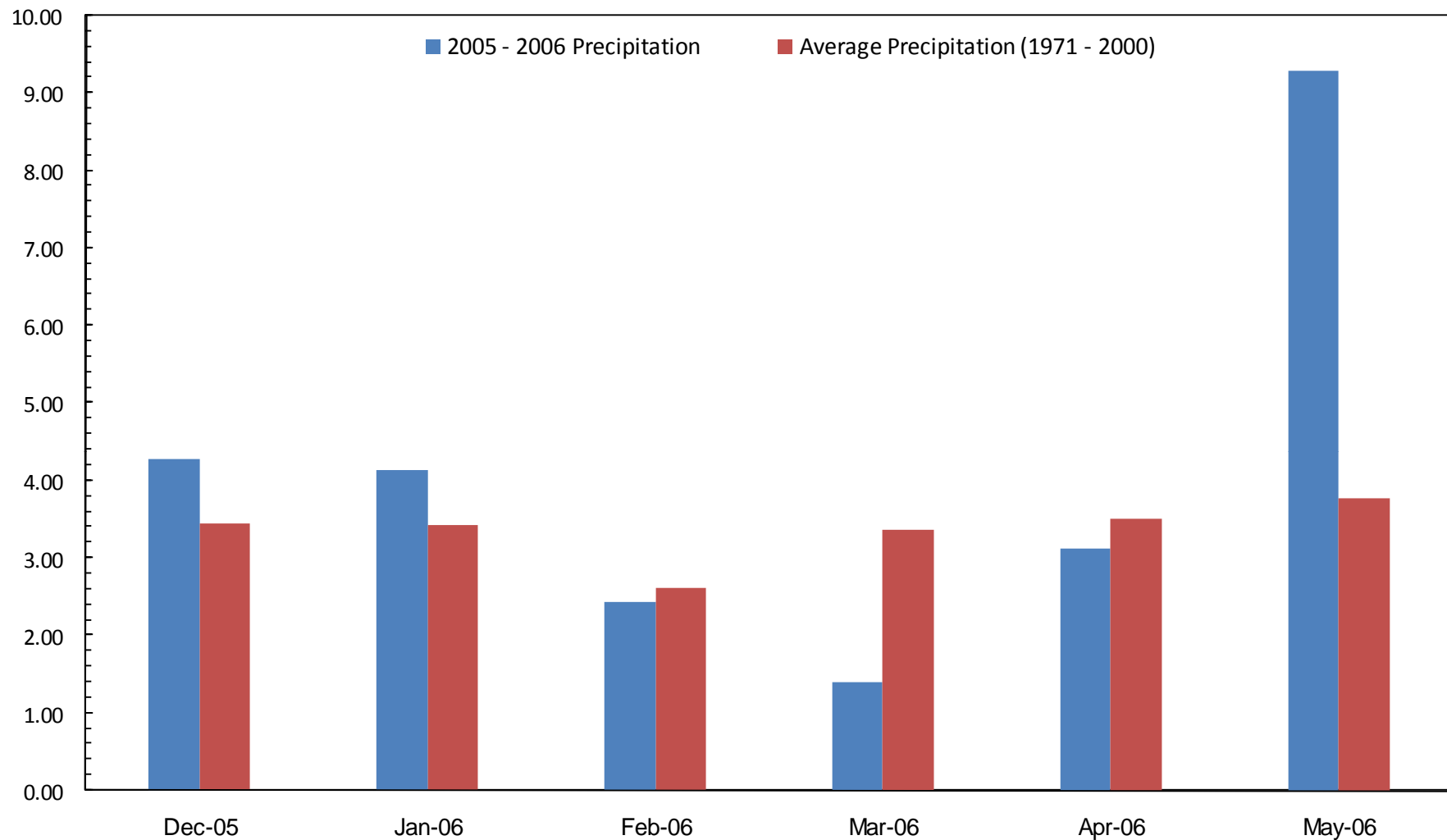


# Selected Stream and Precipitation Gages; May 2006 Flood



# Selected Stream and Precipitation Gages; April 2007 Flood

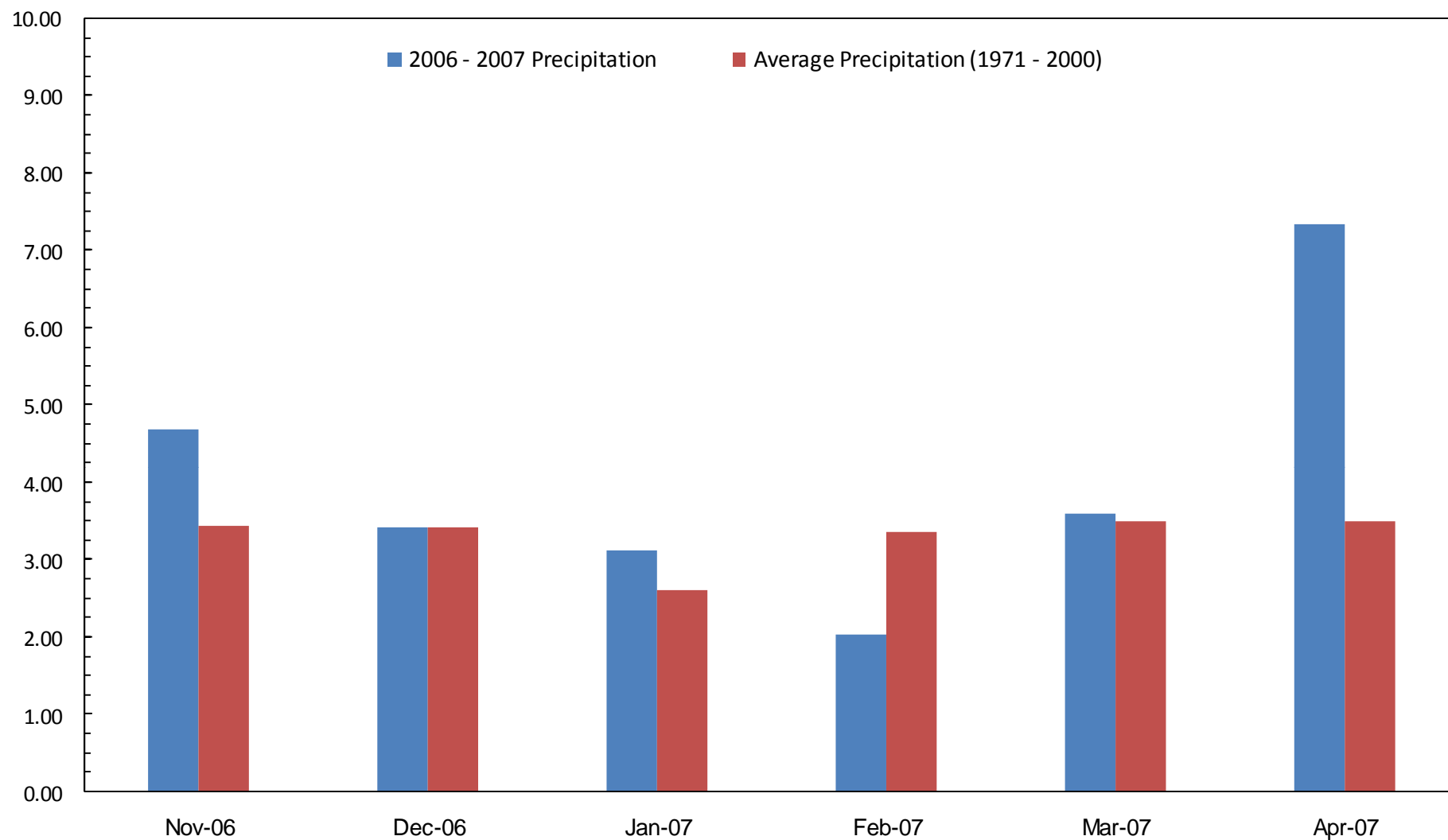




**Figure 3. New Hampshire Monthly Precipitation  
for Winter & Spring 2005 - 2006**



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**Figure 7. New Hampshire Monthly Precipitation  
for Winter & Spring 2006 - 2007**



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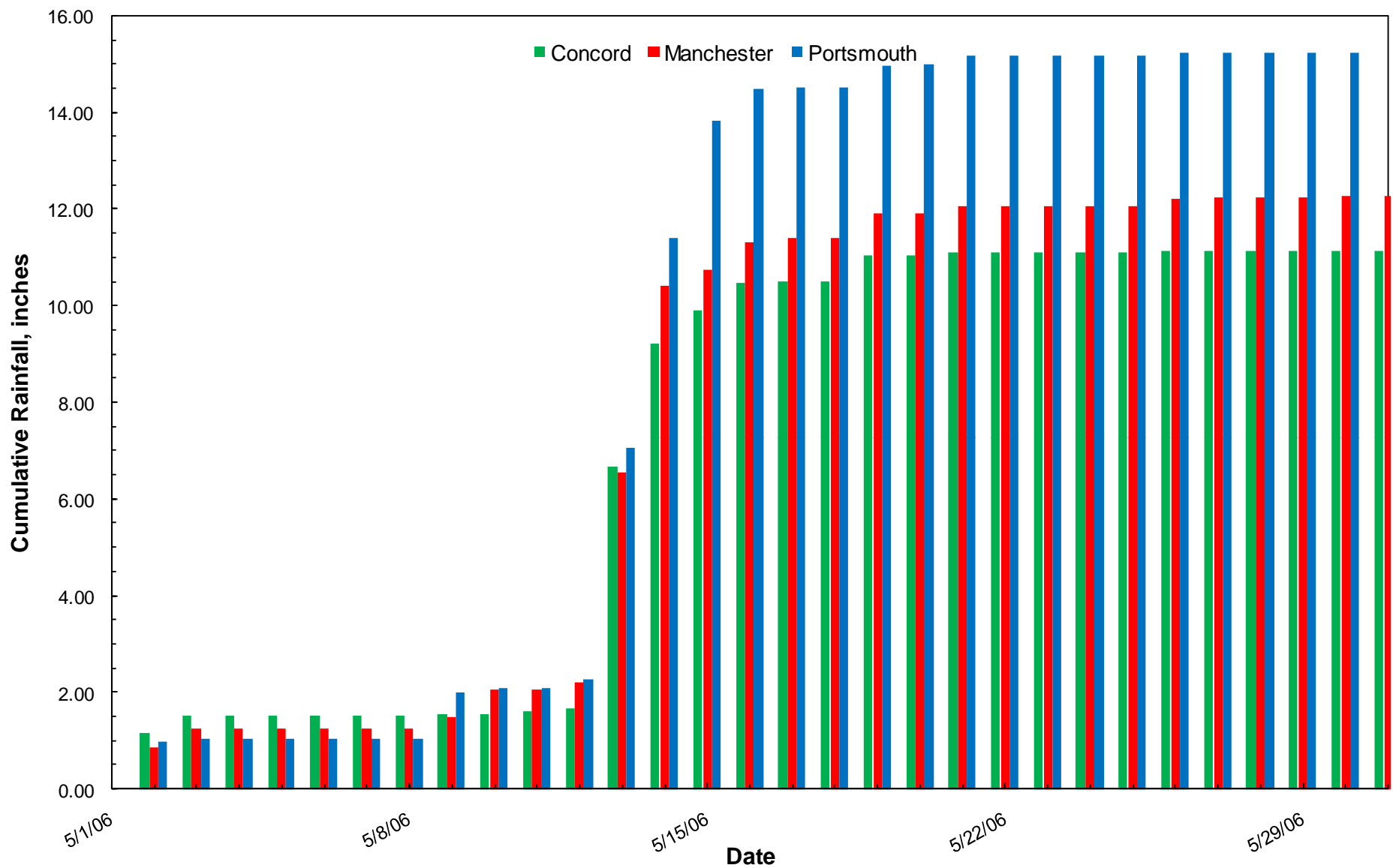


Figure 4. Cumulative Daily Rainfall Totals, May 2006



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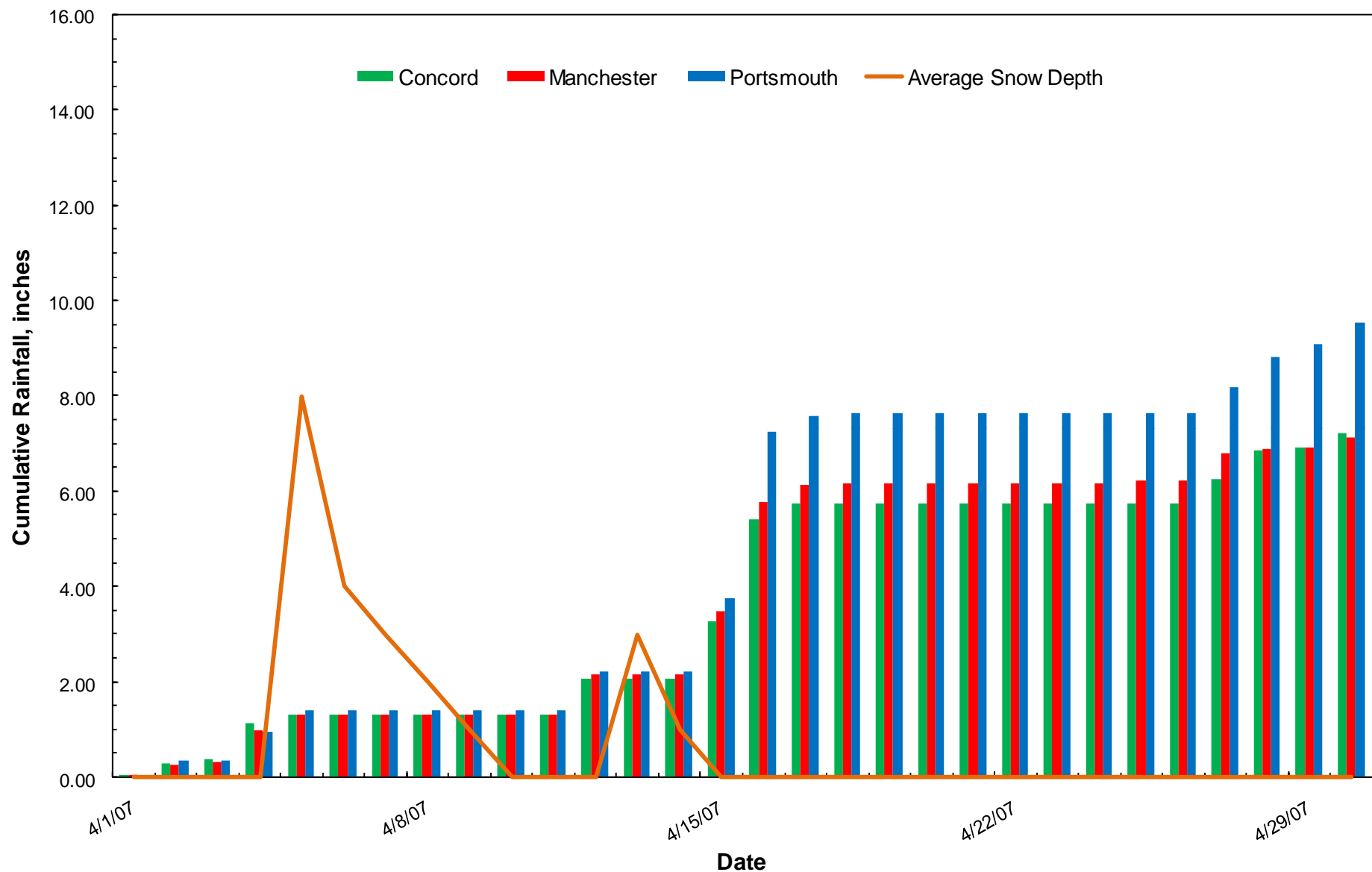
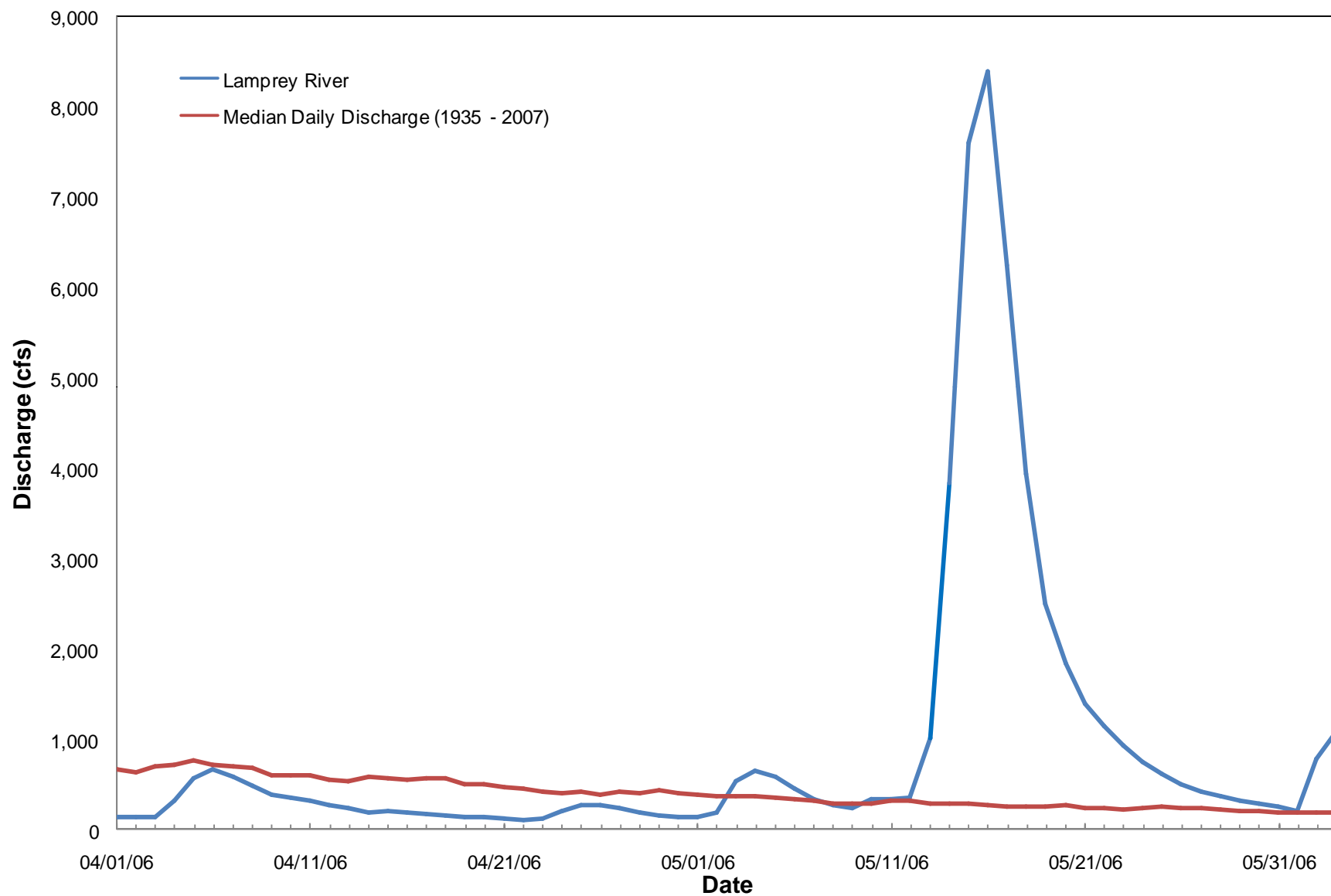


Figure 8. Cumulative Daily Rainfall Totals, April 2007



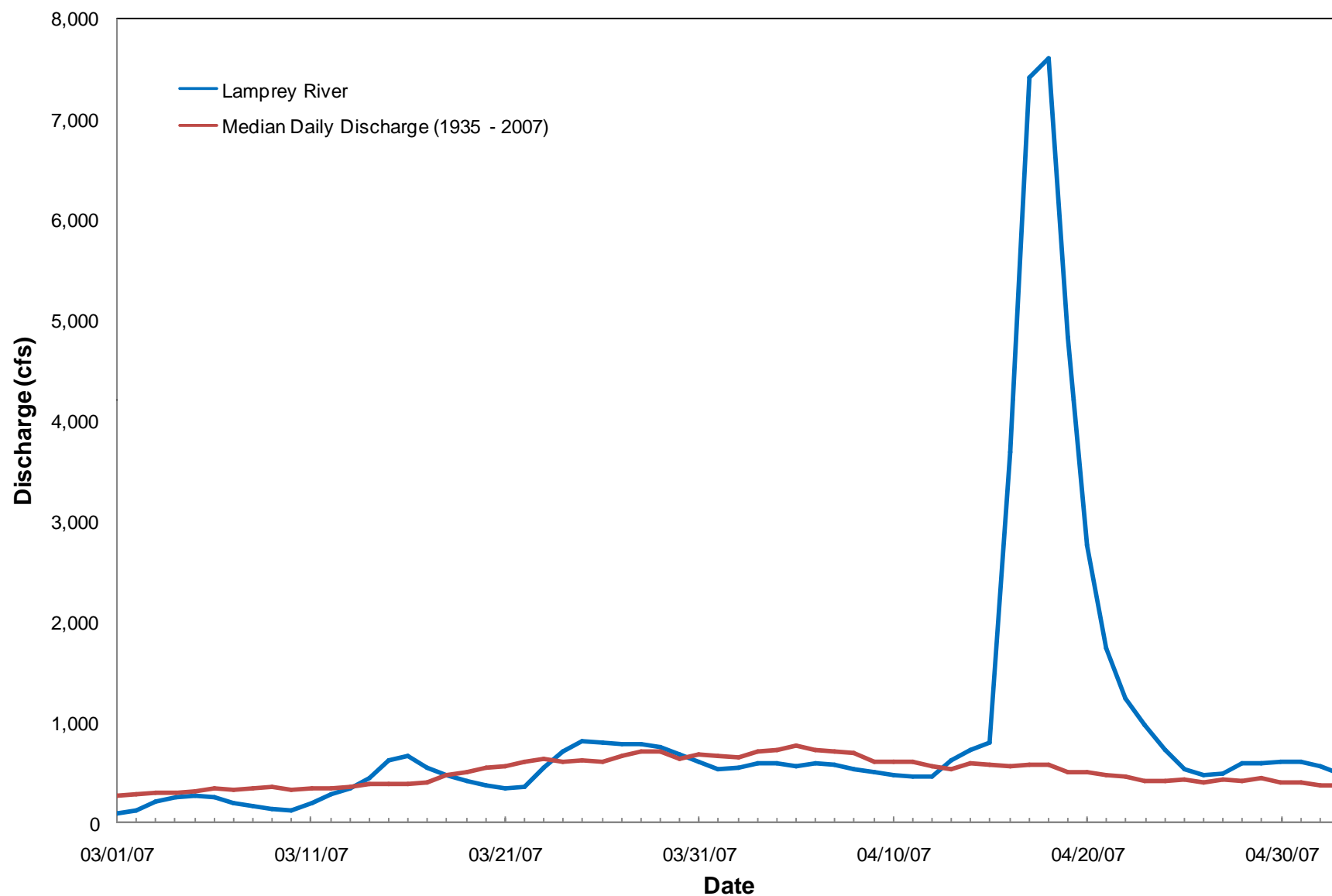
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## Lamprey River near Newmarket (01073500) Daily Discharge April - May 2006



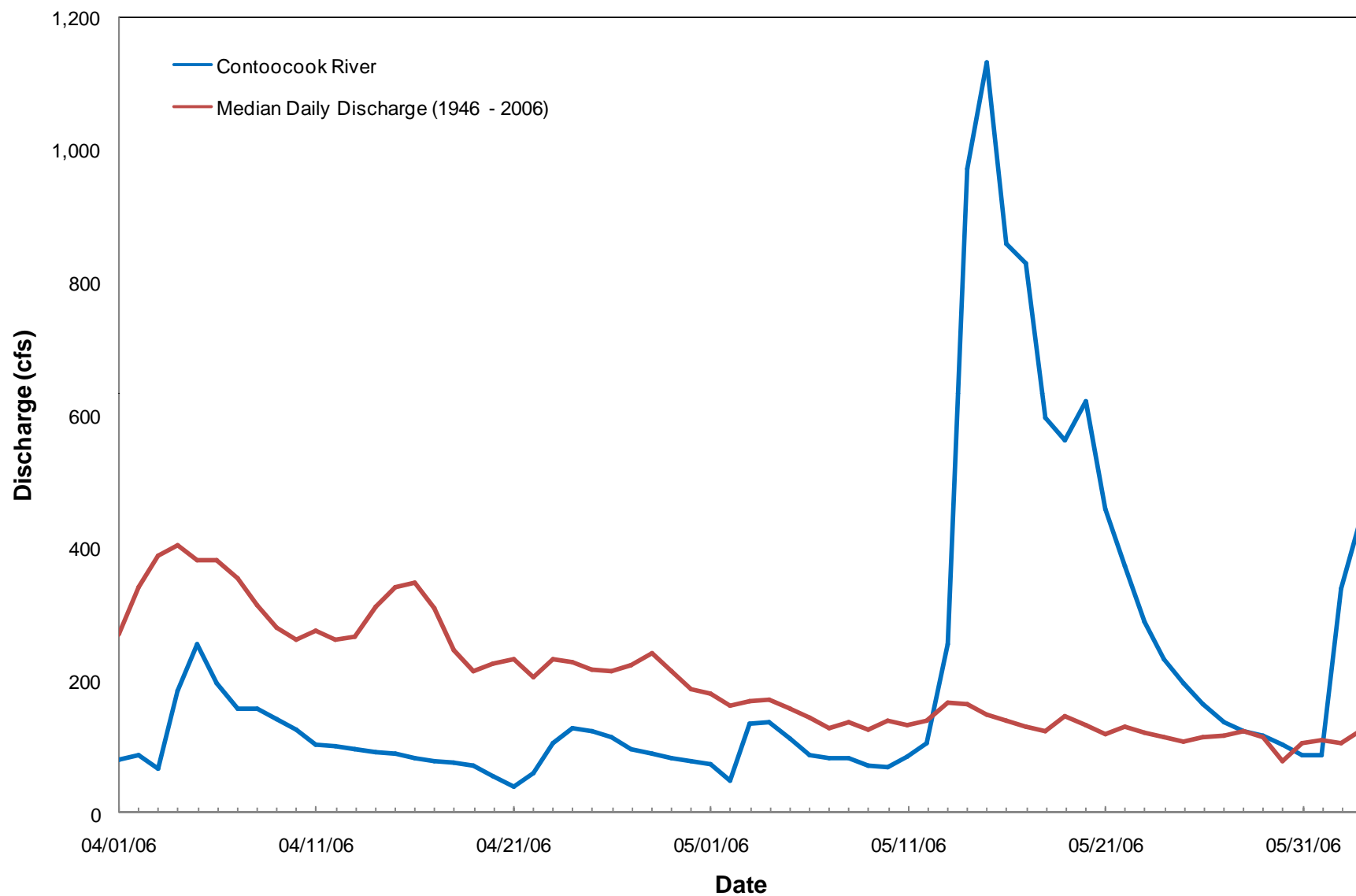
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## Lamprey Rv near Newmarket (01073500) Daily Discharge March - April 2007



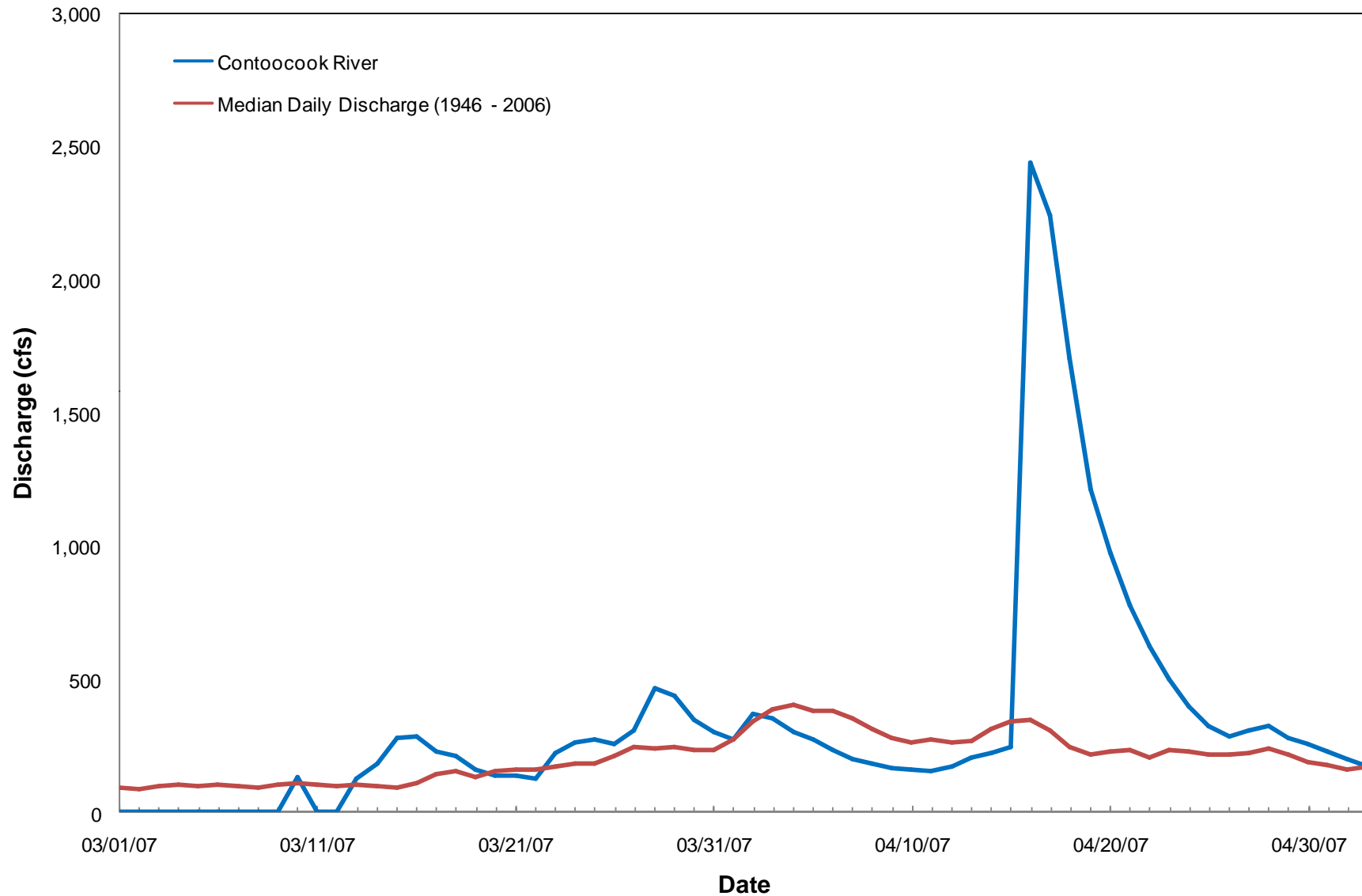
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## Contoocook River at Peterborough (01082000) Daily Discharge April - May 2006



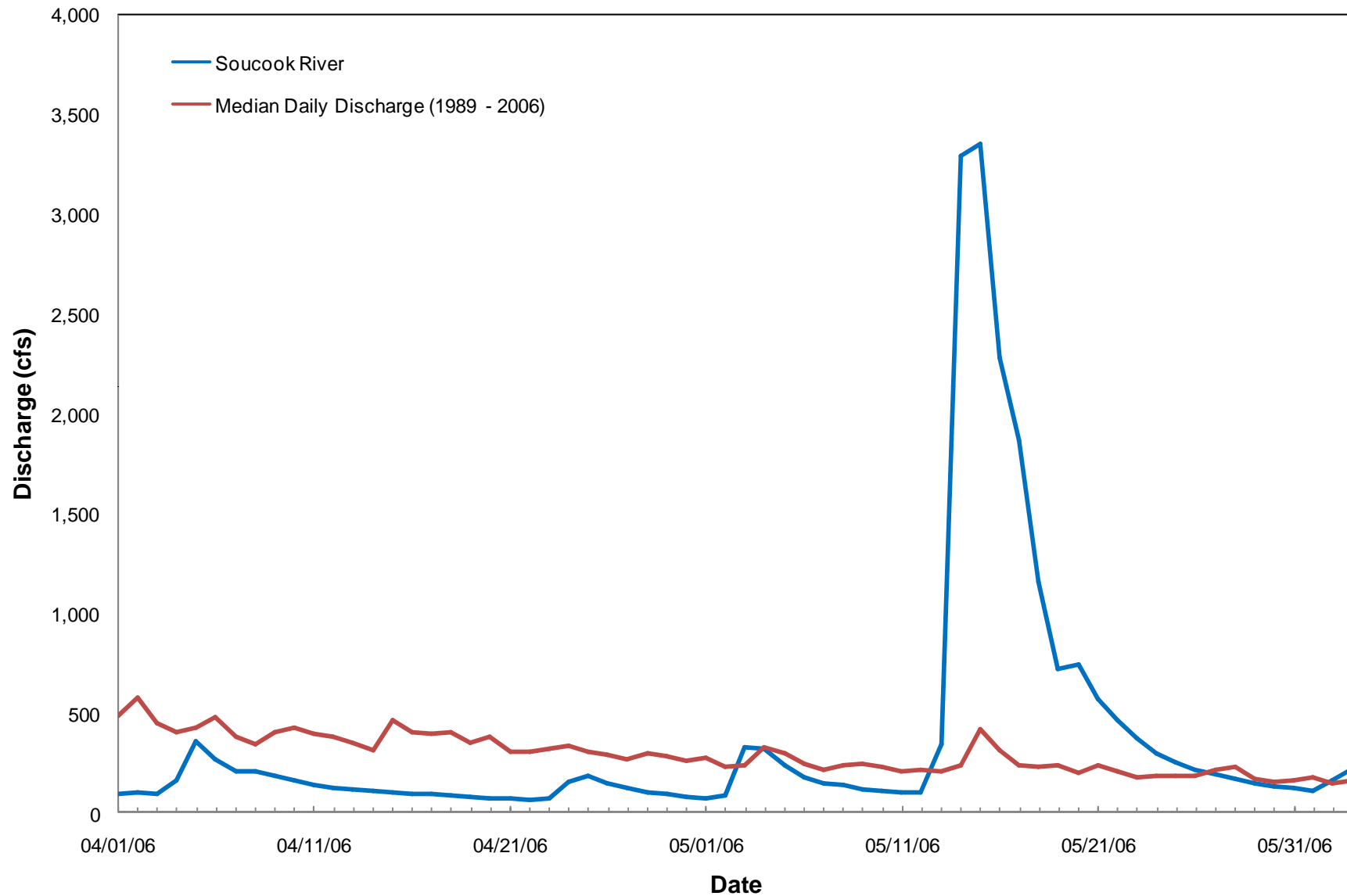
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## Contoocook Rv at Peterborough (01082000) Daily Discharge March - April 2007



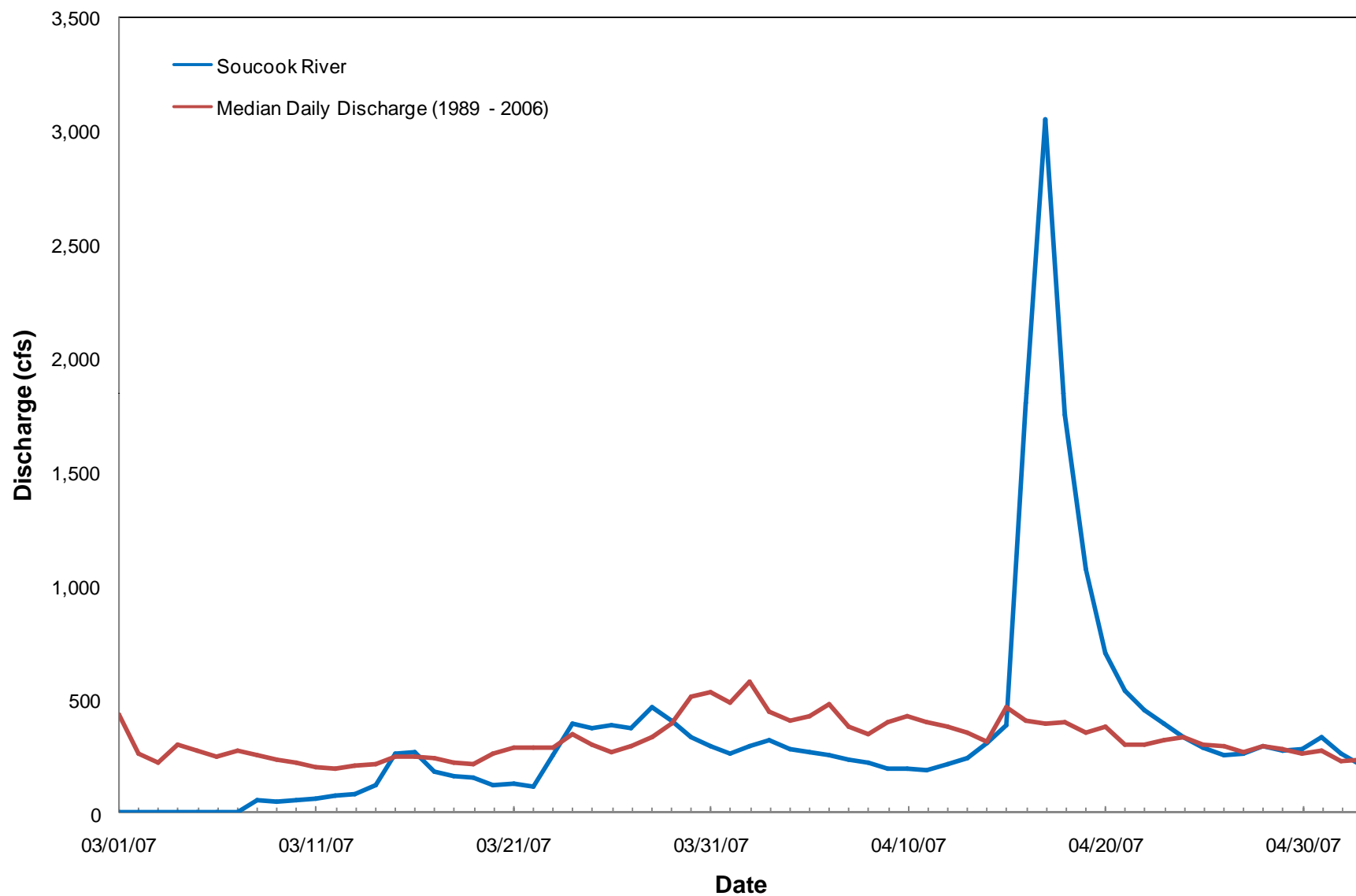
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## Soucook River near Concord (01089100) Daily Discharge April - May 2006



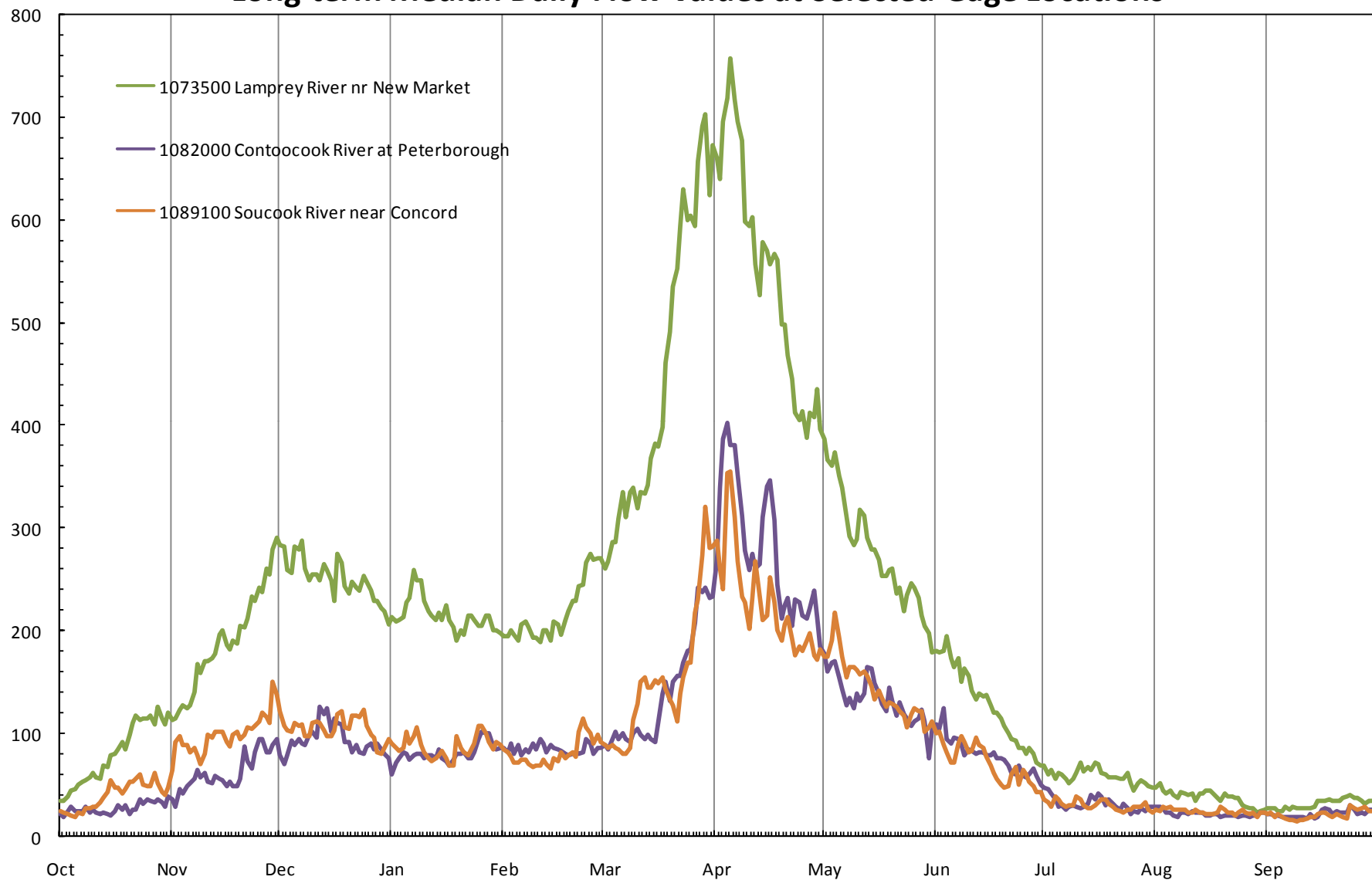
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## Soucook River near Concord (01089100) Daily Discharge March - April 2007



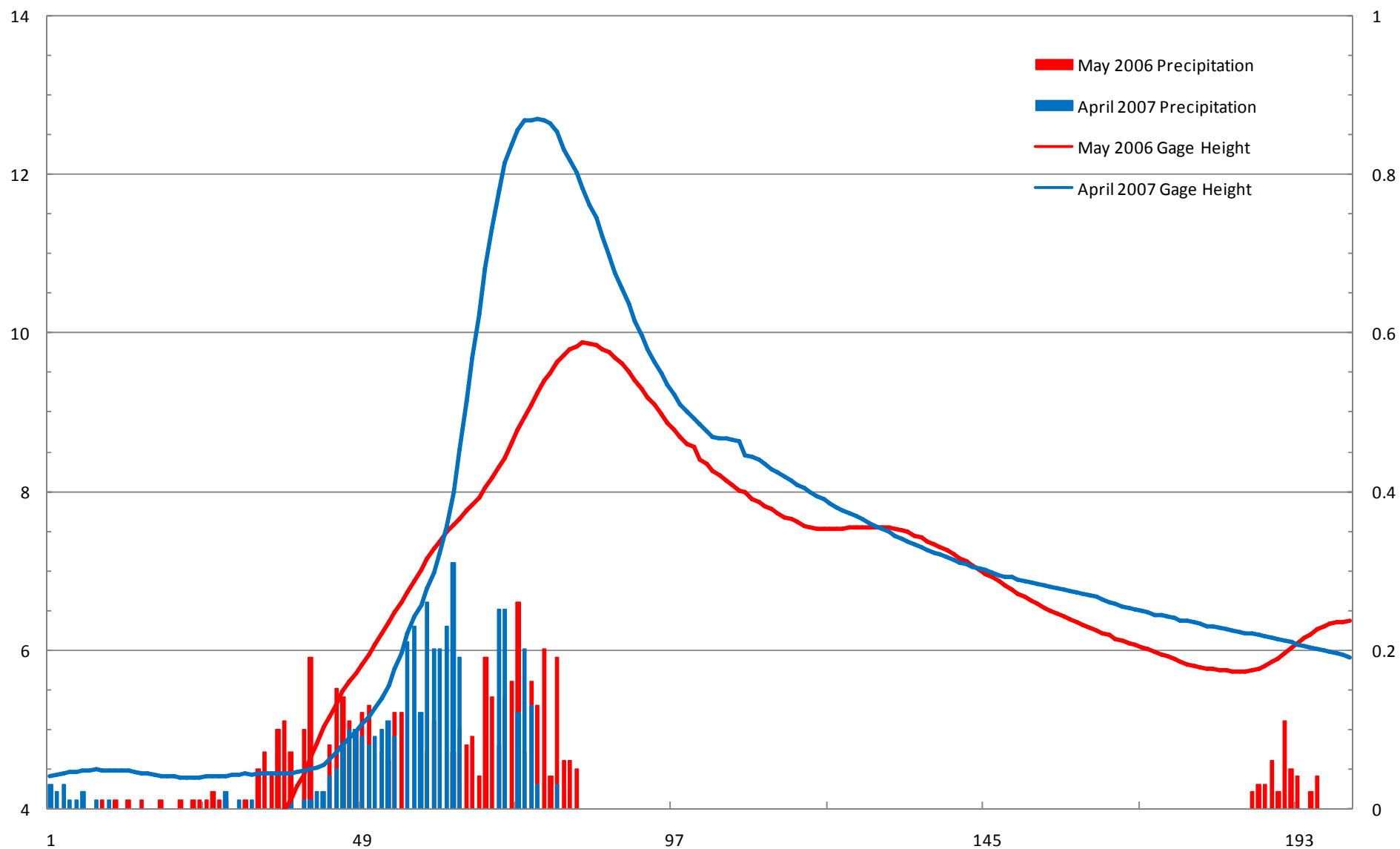
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## Long-term Median Daily Flow Values at Selected Gage Locations



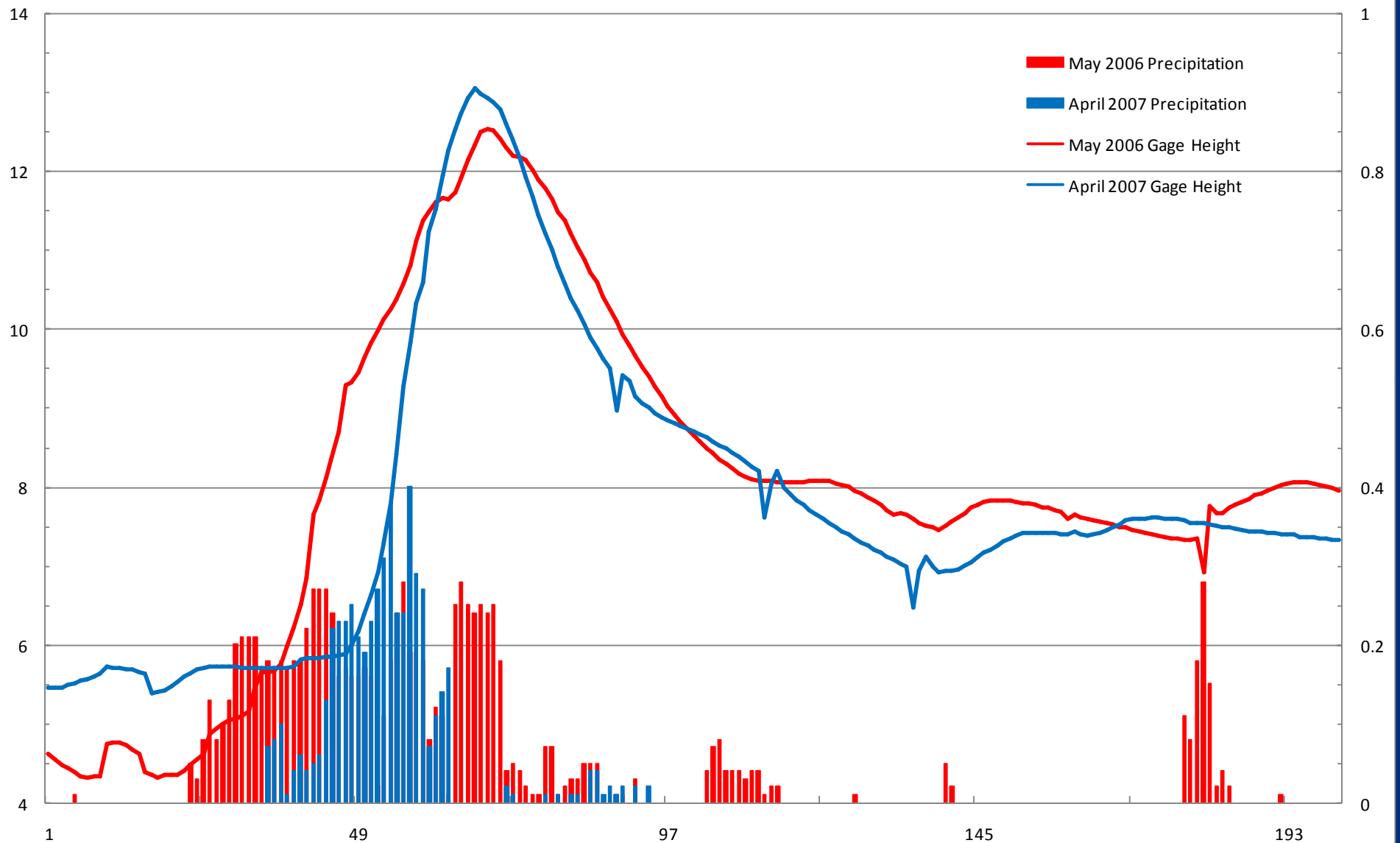
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## Souhegan River near Merrimack



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## Piscataquoq River at Goffstown



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# Summary of Rainfall Comparisons

- Both the April and May storms were severe. Often they were record setting.
- Their severity was very dependent on location, local rainfall patterns, and prior conditions. The May storm was more widespread while the April storm was more intense in the Souhegan, Contoocook, Suncook and the Piscataquog.
- May flooding was caused by long, moderate intensity rainfall. The April storm was caused by very intense rainfall coupled with rapid snowmelt attributable to rising temperatures.
- At long term gage sites near the Seacoast (Oyster River and the Lamprey River), both the May storm and the April storm were record setting. However, larger storms have been recorded at other locations



# Flood Control Dams

- Specifically build to prevent downstream flooding
- Large size
- Typically empty in-between storms
- Store floodwaters during a storm and release it afterwards



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# Run-of-the-River Dams

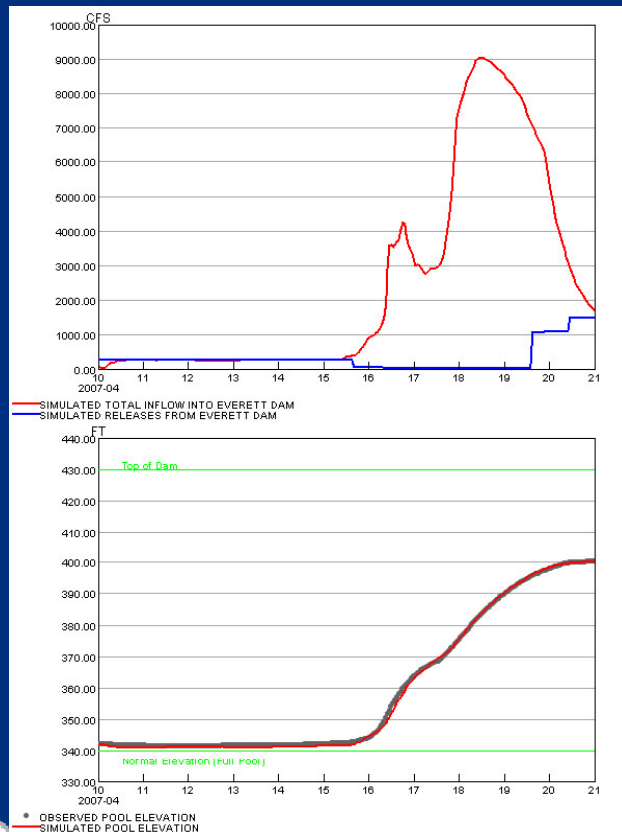
- Smaller dams in the river
- Generally constructed as mill dams, now often used for hydropower
- Some not used anymore



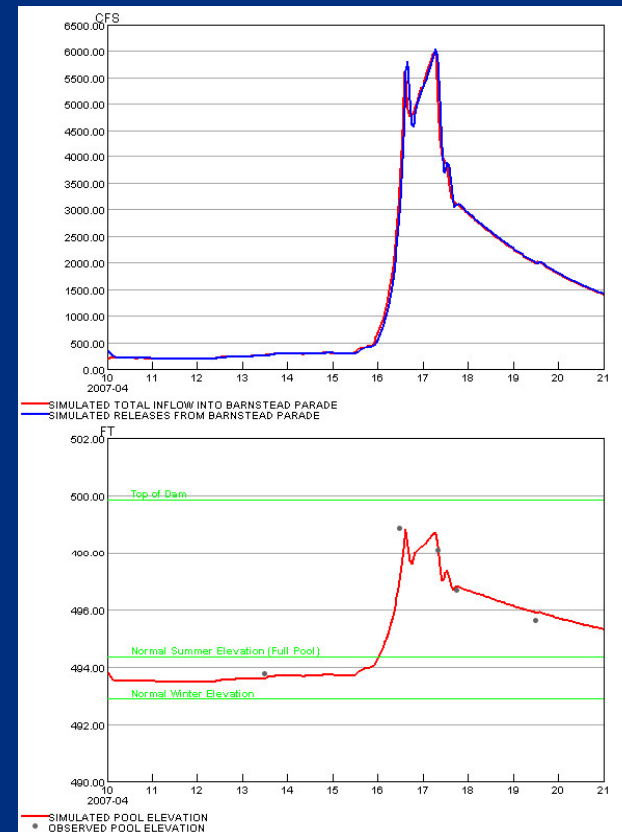
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# Comparing Flood Control and Run-of-River Dams

## Everett Dam – Flood Control

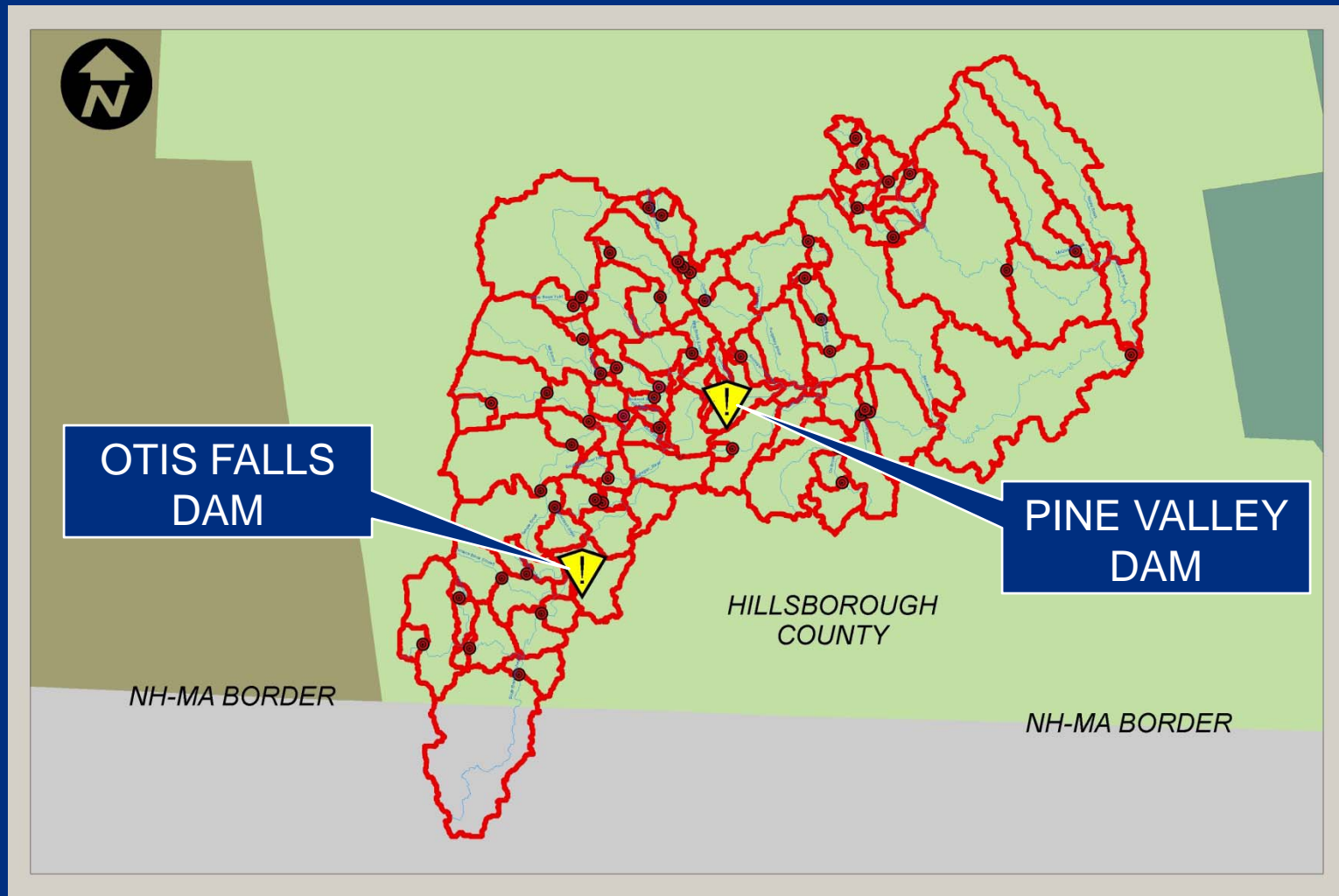


## Barnstead Parade – Run of River



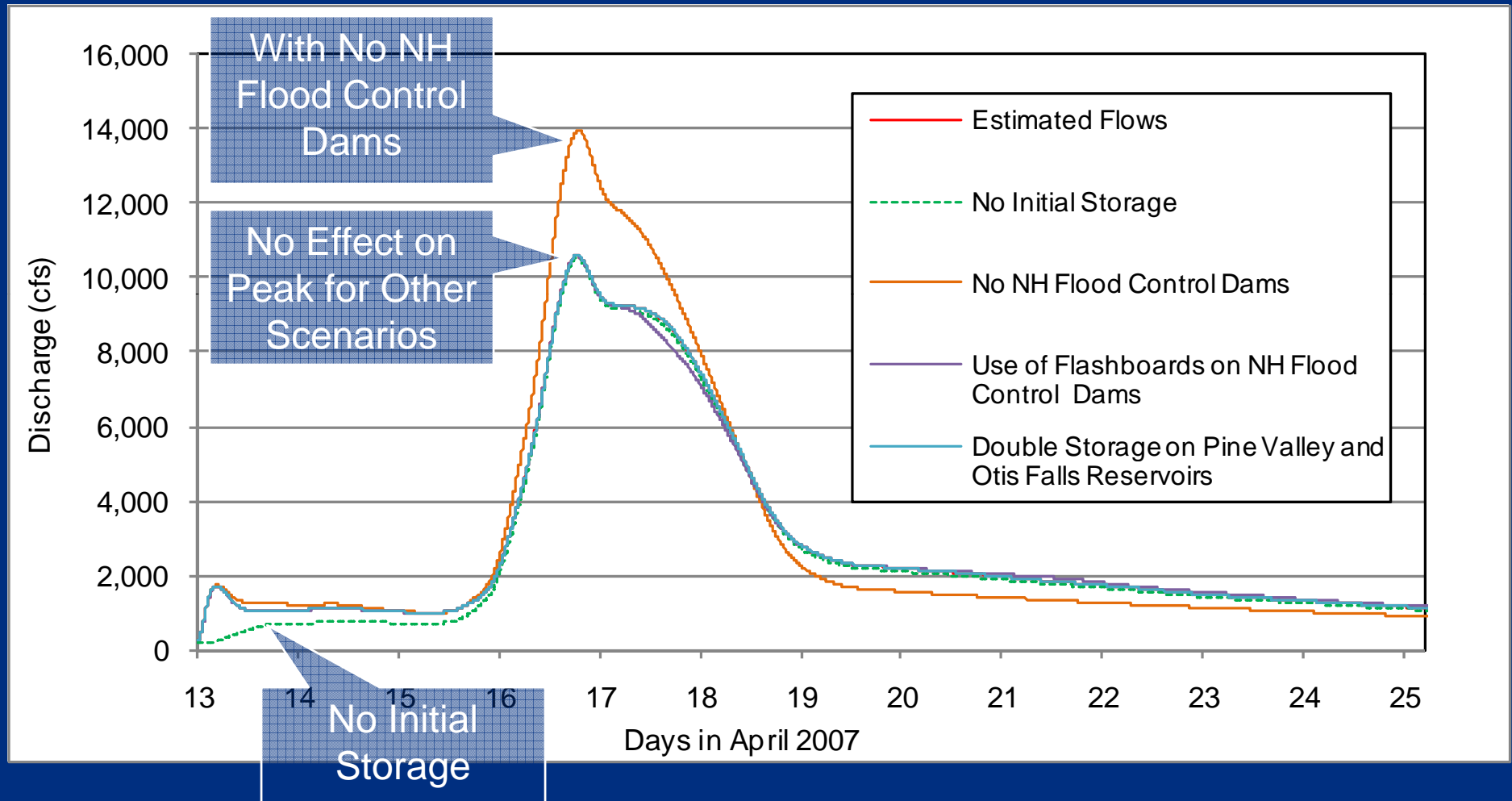
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# Dam Operations – Souhegan Basin



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# Dam Operations – Souhegan Basin



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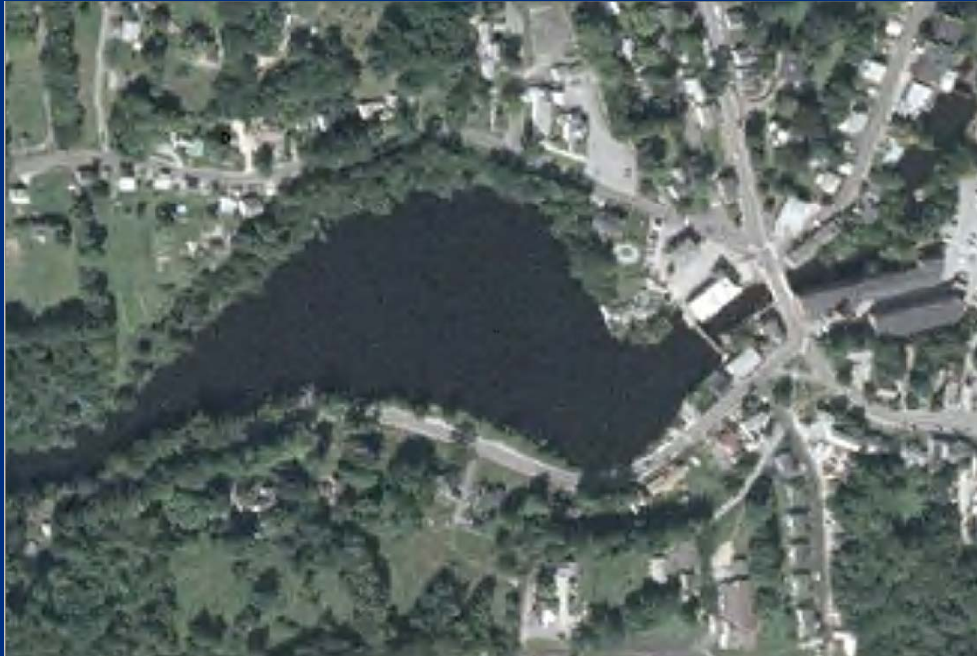
# Dam Operations – Souhegan Basin

## Overall Basin Summary

- Modeling efforts included every dam with available data (60 impoundments)
- Magnitude of extreme flooding (i.e., April 2007) is not affected by any dam operations since the amount of overall basin flood control storage is relatively small
- Flashboard operations only affect the immediate downstream areas and do not affect the overall magnitude of extreme flooding
- The 13 NH flood control dams reduce the effects of extreme flooding by at about 40% (they help more during minor storms)



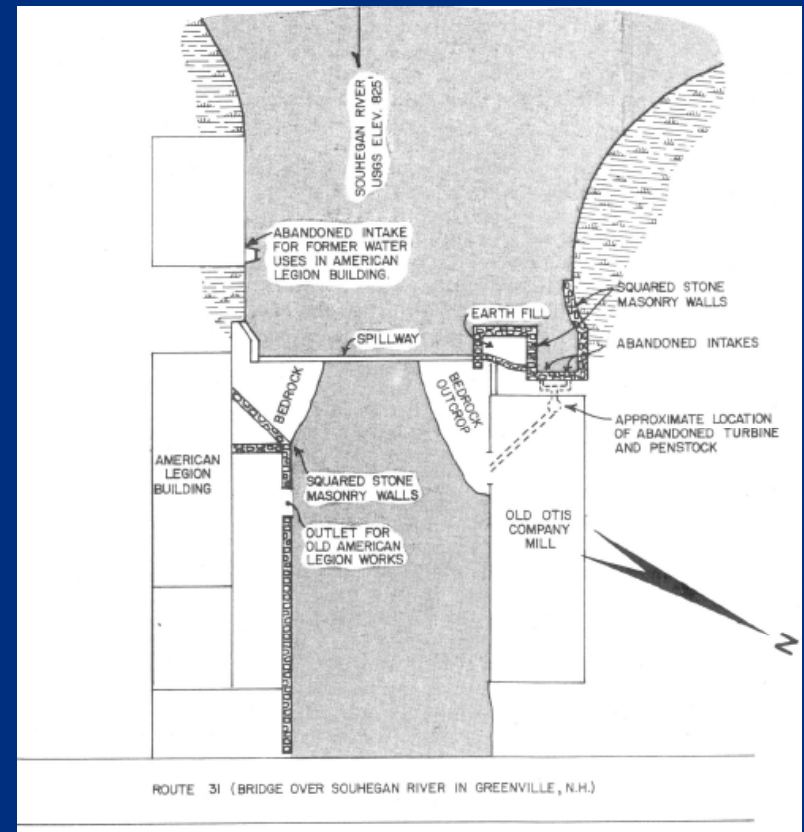
# Dam Operations – Souhegan Basin



## Otis Falls

### Otis Falls Critical Data

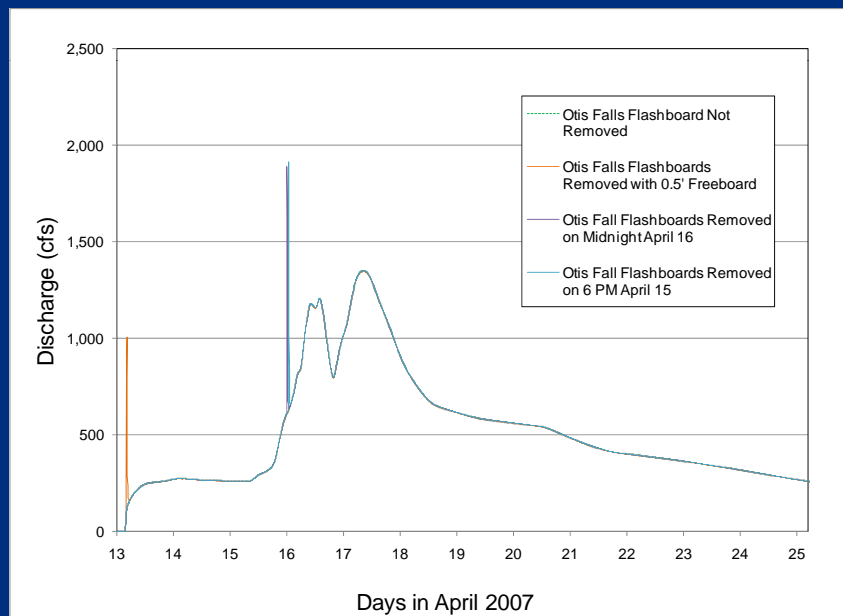
- Storage: 105 acre-feet
- Drainage area: 30 mi<sup>2</sup>
- 3' Manual flashboards
- Takes only 0.07" of runoff to fill



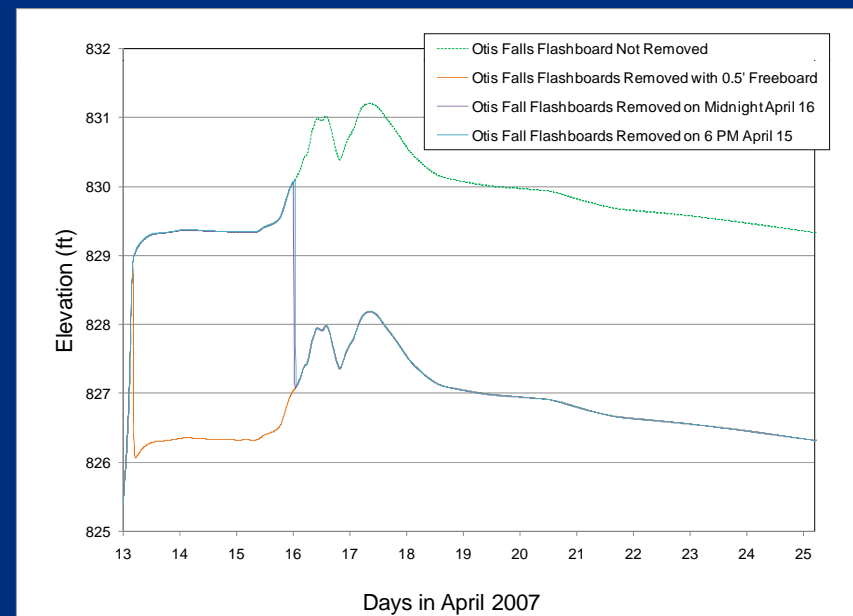
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# Otis Falls Dam Operations

Discharge out of dam



Water level on impoundment



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# Dam Operations – Souhegan Basin

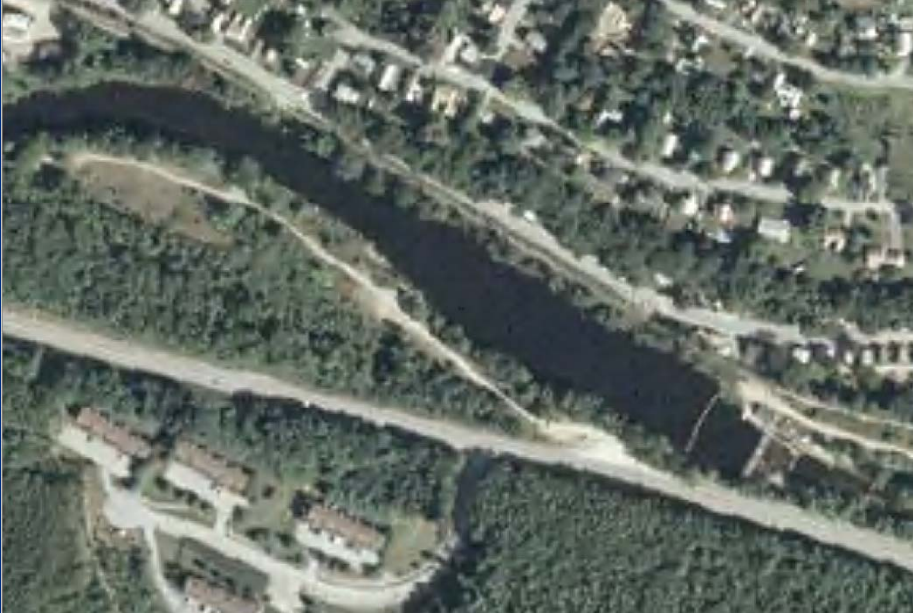
## Otis Falls Summary

- Timing of flashboard removal affected the immediate downstream area (Greenville) but effect was minimal further downstream
- Early removal of flashboards can decrease magnitude of flooding immediately downstream
- Dam is too small to have a major impact on entire basin regardless of flashboard operating rules



# Dam Operations – Souhegan Basin

## Pine Valley Mills

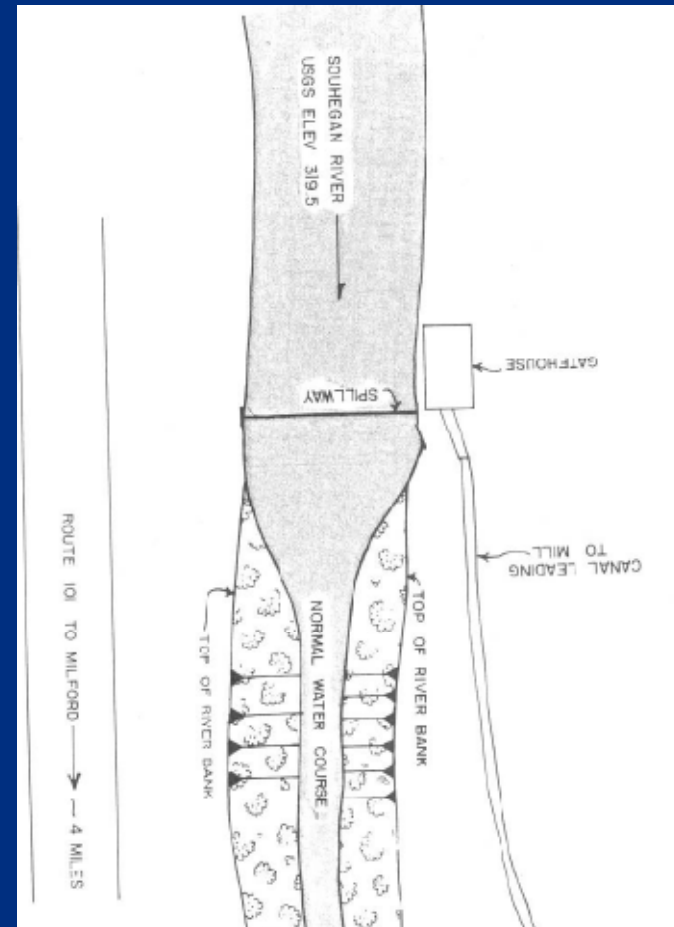


### Pine Valley Mills Critical Data

- Storage: 70 acre-feet
- Drainage area: 97 mi<sup>2</sup>
- 4' automatic flashboards
- Takes only 0.01" of runoff to fill lake

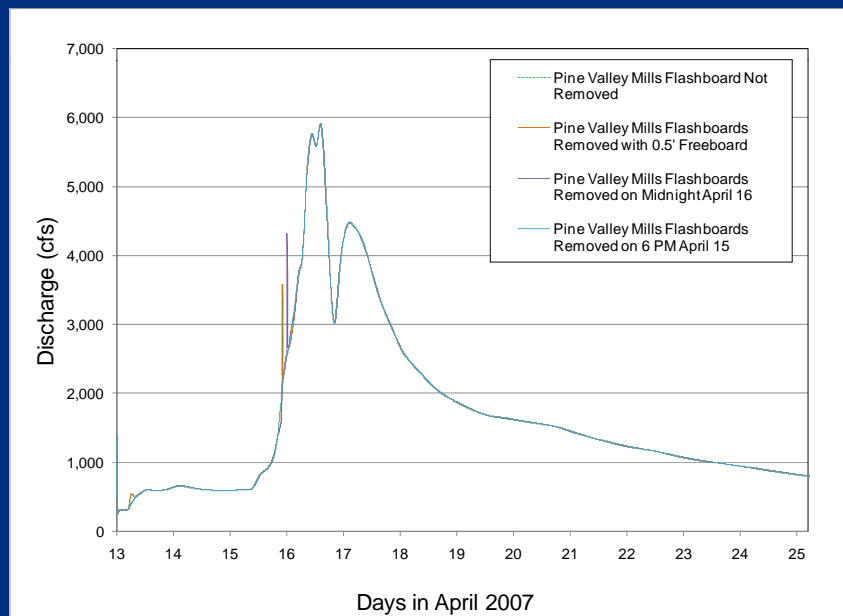


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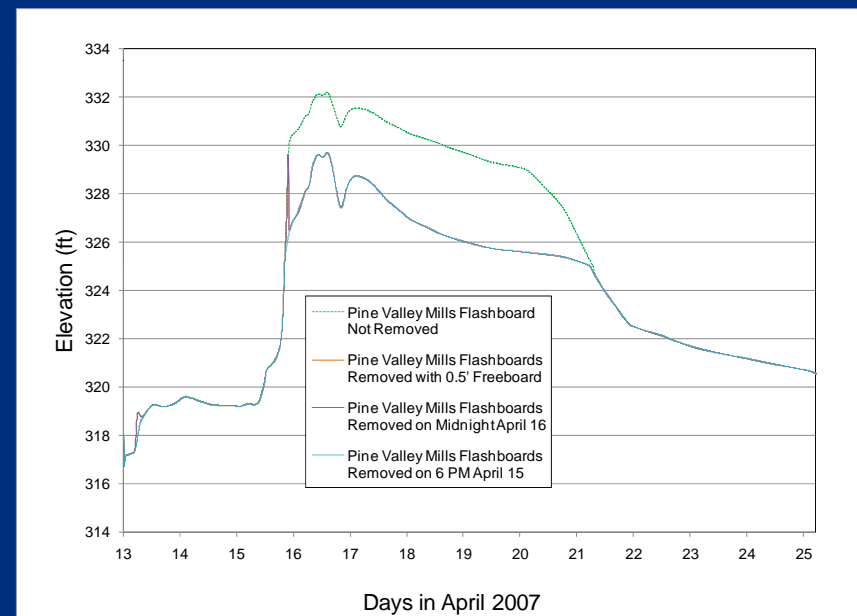


# Pine Valley Dam Operations

## Discharge out of dam



## Water level on impoundment

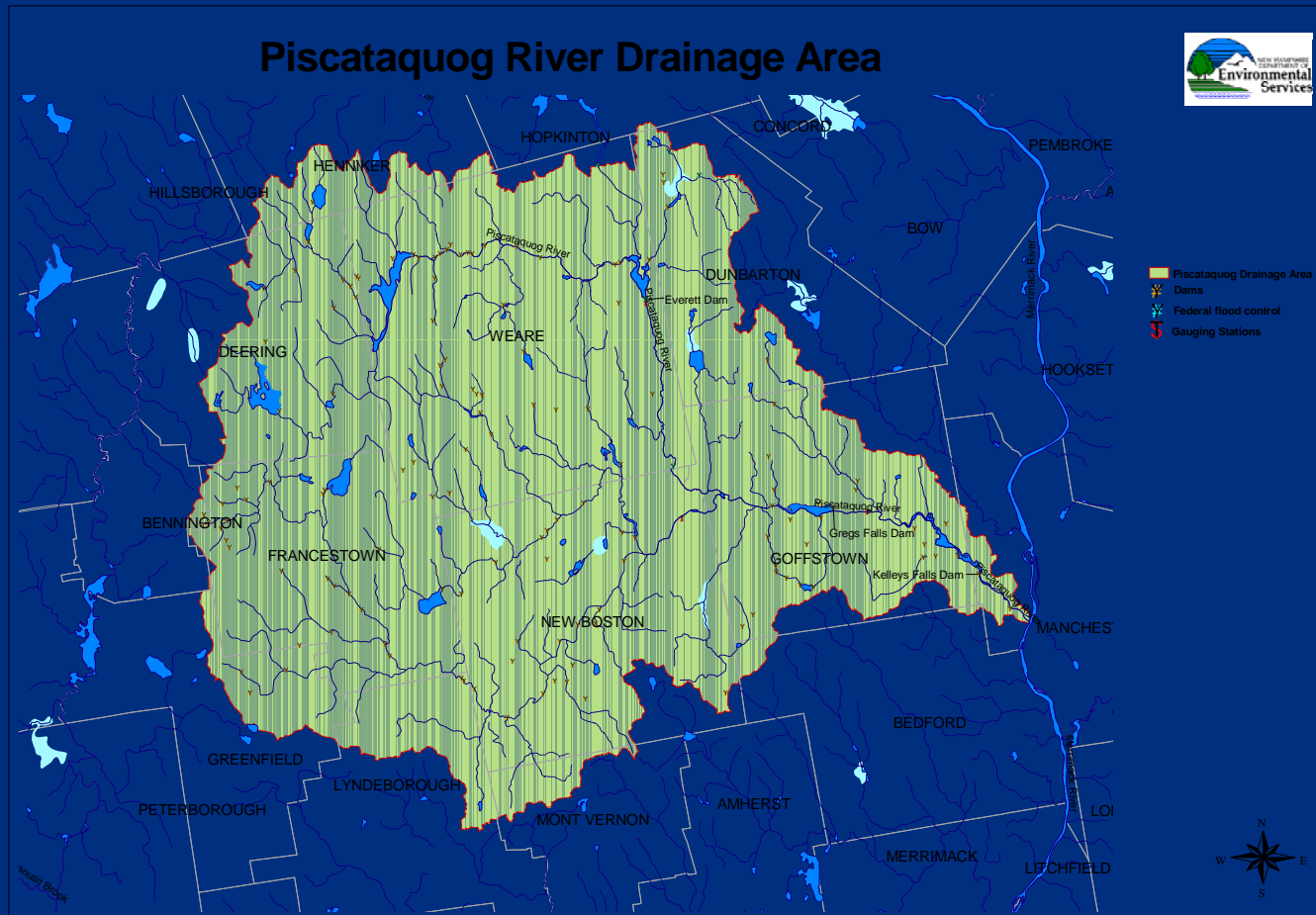


# Dam Operations – Souhegan Basin

## Pine Valley Mills Summary

- Flashboards activate approximately 1' of overtopping
- Timing of when flashboards trip during April 2007 storm is not critical since the magnitude of storm is too great.
- The outlet works should be operated to release the maximum amount of water during a significant storm event
- Dam is too small to have a major impact on entire basin regardless of flashboard operating rules

# Dam Operations – Piscataquog River Basin



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# Dam Operations – Piscataquog Basin



## Gregg's Falls

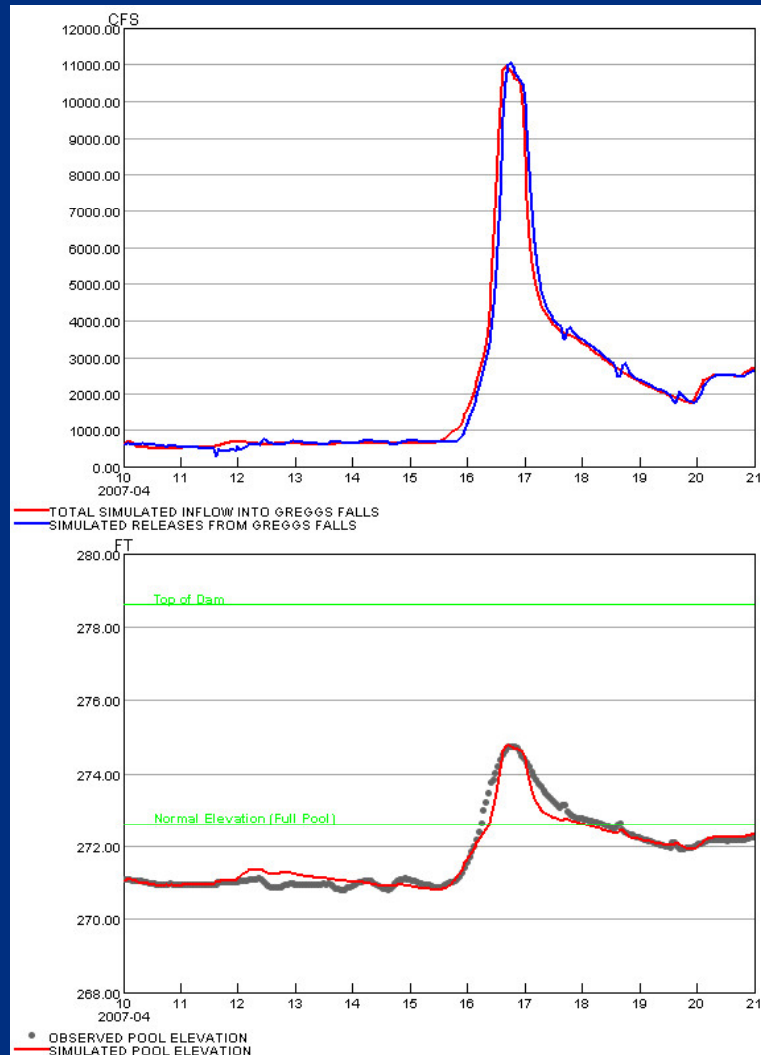
### Gregg's Falls Critical Data

- Storage: 4,700 acre-feet
- Drainage area: 200 mi<sup>2</sup>
- Provision for flashboards, two gates, turbines, fishway
- 0.27 inches of runoff fills lake



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# Dam Operations – Gregg's Falls

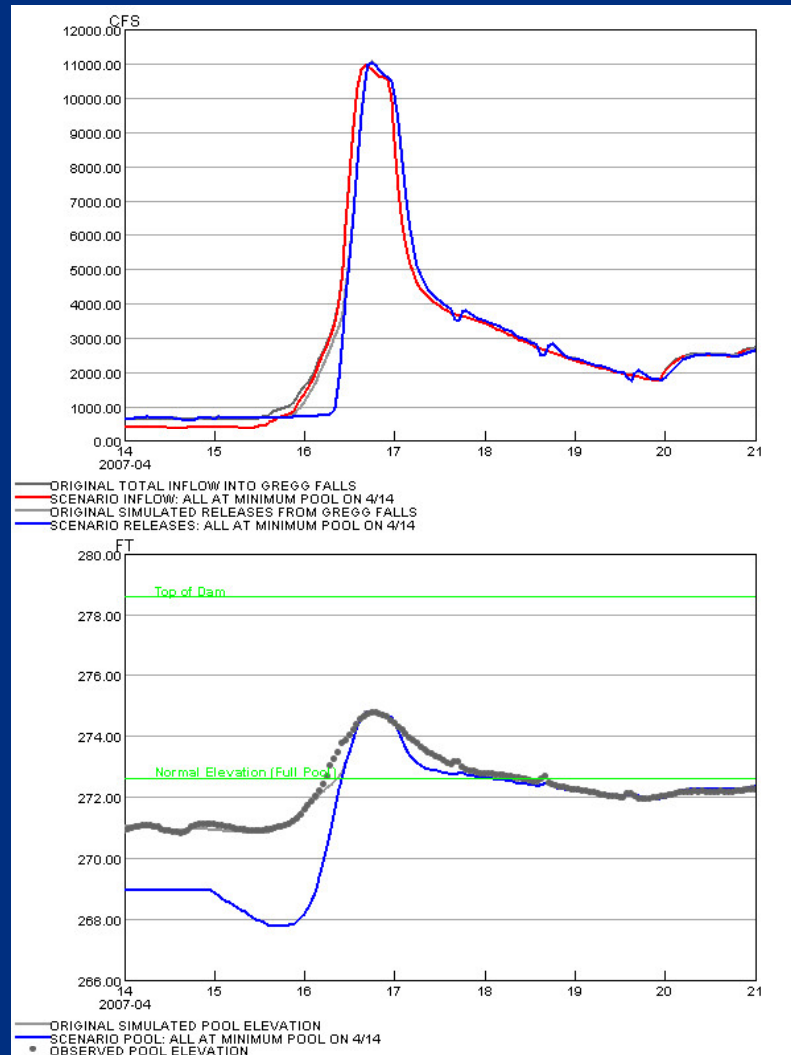


- Inflow = Outflow
- Given it's drainage area, very little room for storage



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# Dam Operations – Gregg's Falls



- Evaluated what would happen if pond elevation is as low as possible at beginning of storm
- Storage is filled quickly with little impact

# Dam Operations – Piscataquog Basin

## Gregg's Falls Summary

- The size of the upstream drainage area precludes flood control benefits at this facility. The impoundment can capture only 0.27 inches of runoff.
- There is already significant flood control in the system, at Everett Dam. This reduces discharges to almost zero from 30% of the basin.
- We tried simulations lowering the upstream water levels down to winter normal pool. They made virtually no difference on the outflow from the facility or the maximum water level on the impoundment.
- We tried using Gregg's Falls for "Flood Control" by lowering the impoundment and leaving the flashboards in. This aggravated conditions downstream because the elevation got high enough to trip the flashboards, and increase the discharge downstream.

# Dam Operations – Piscataquog Basin

## Kelly's Falls



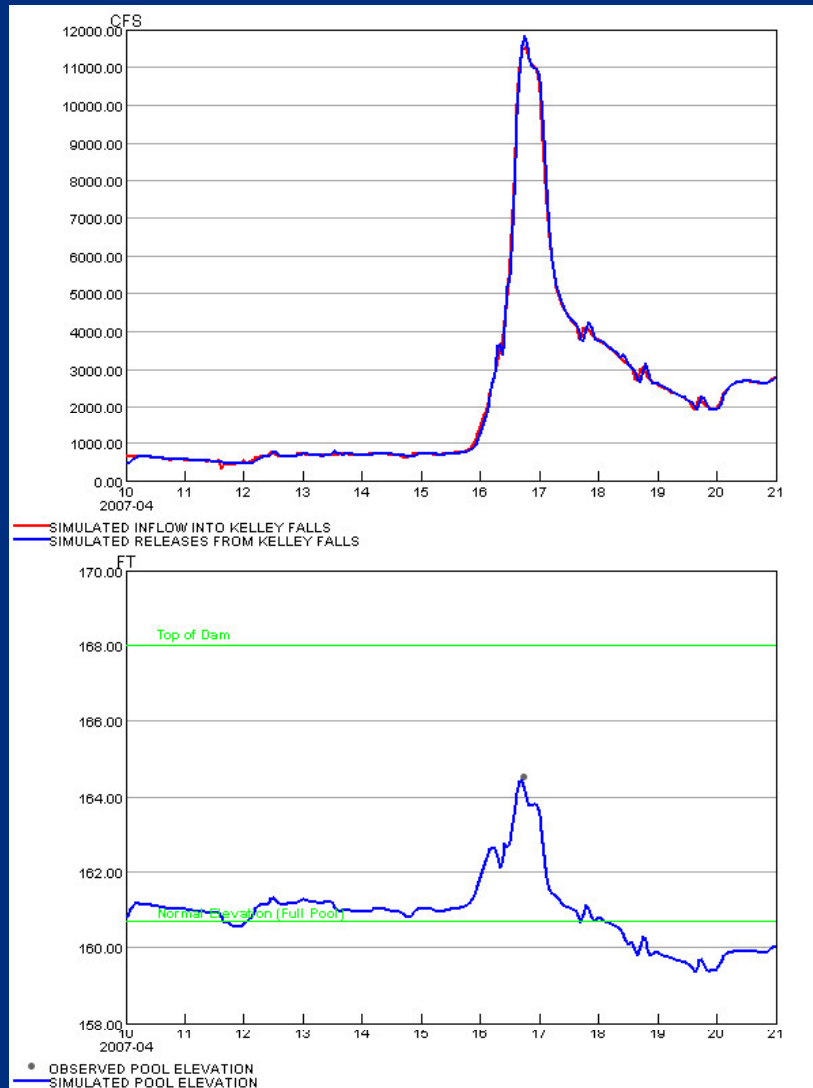
### Kelly's Falls Critical Data

- Storage: 2,290 acre-feet
- Drainage area: 214 mi<sup>2</sup>
- Fish bypass, turbine, gates, and flashboards
- 0.11 inches of runoff fills lake



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# Dam Operations – Kelly's Falls

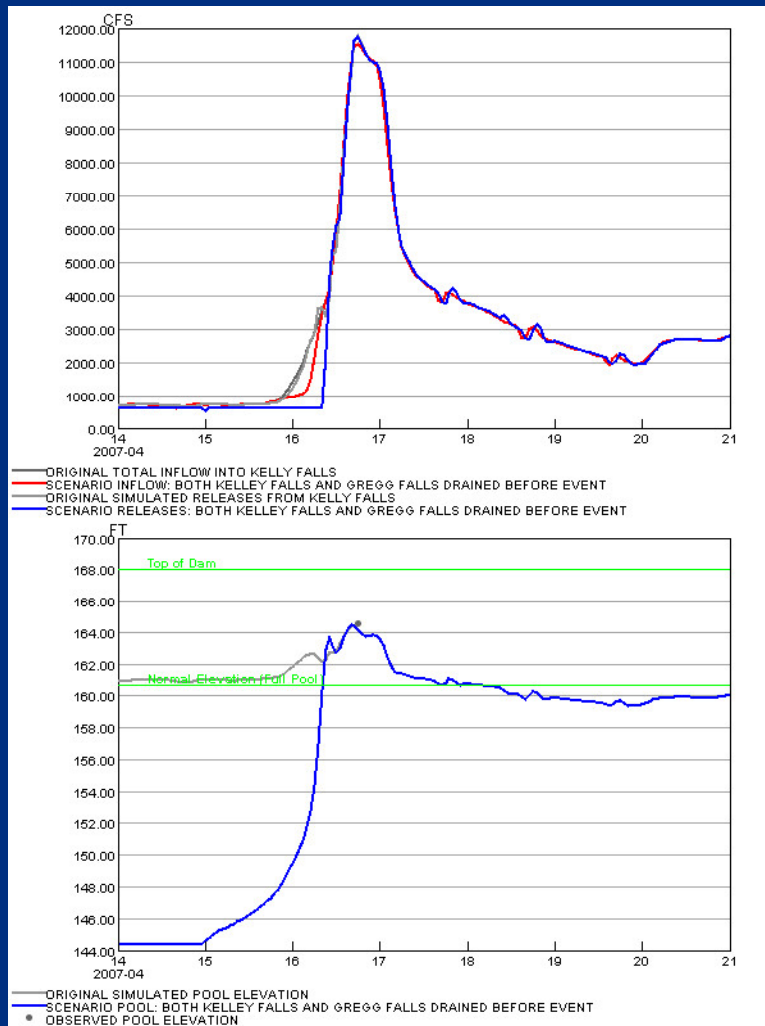


- Blockages at the RR trestle upstream of the dam were reported to be severe. This could be the reason for the upstream flooding.



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# Dam Operations – Kelly's Falls



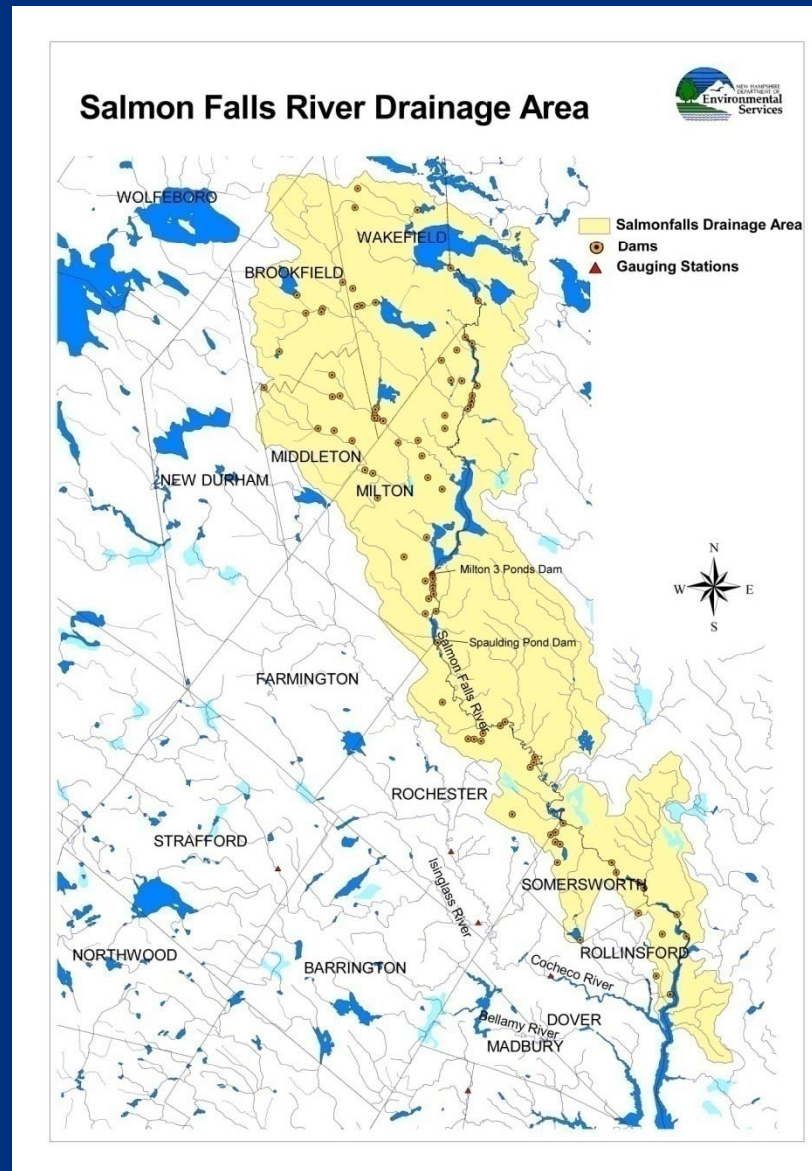
- Evaluated what happens if pond elevation is as low as possible at beginning of storm (theoretical)
- Storage is filled quickly with little impact

# Dam Operations – Piscataquog Basin

## Kelly's Falls Summary

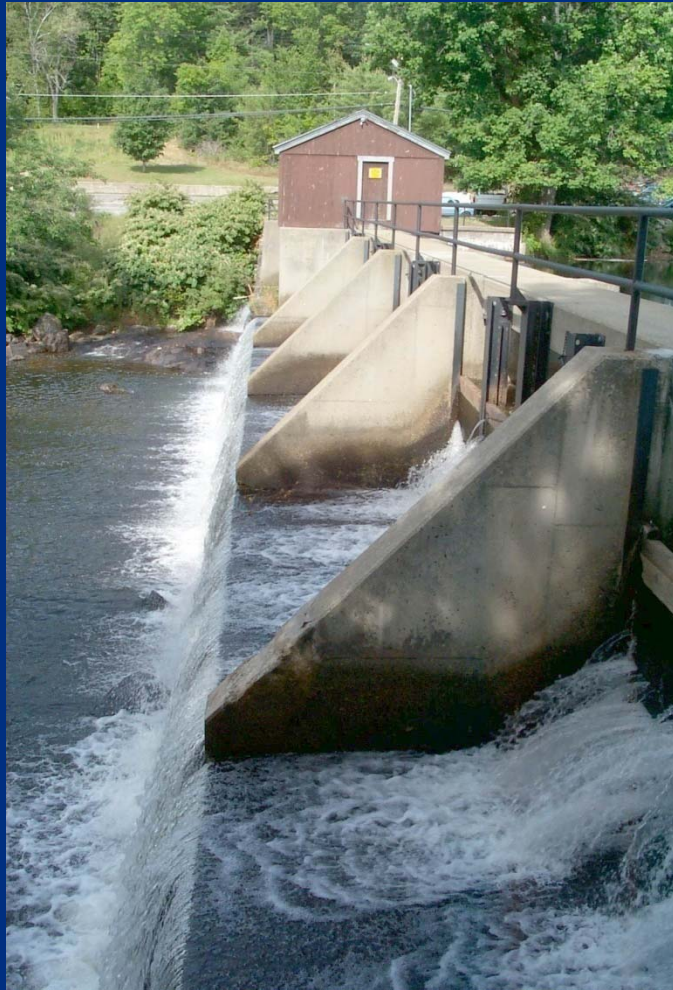
- The size of the upstream drainage area precludes flood control benefits at this facility. The impoundment can capture only 0.11 inches of runoff.
- We tried simulations lowering the upstream water levels down to winter normal pool. They made virtually no difference on the outflow from the facility or the maximum water level on the impoundment.

# Dam Operations – Salmon Falls River



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# Salmon Falls – Milton Three Ponds



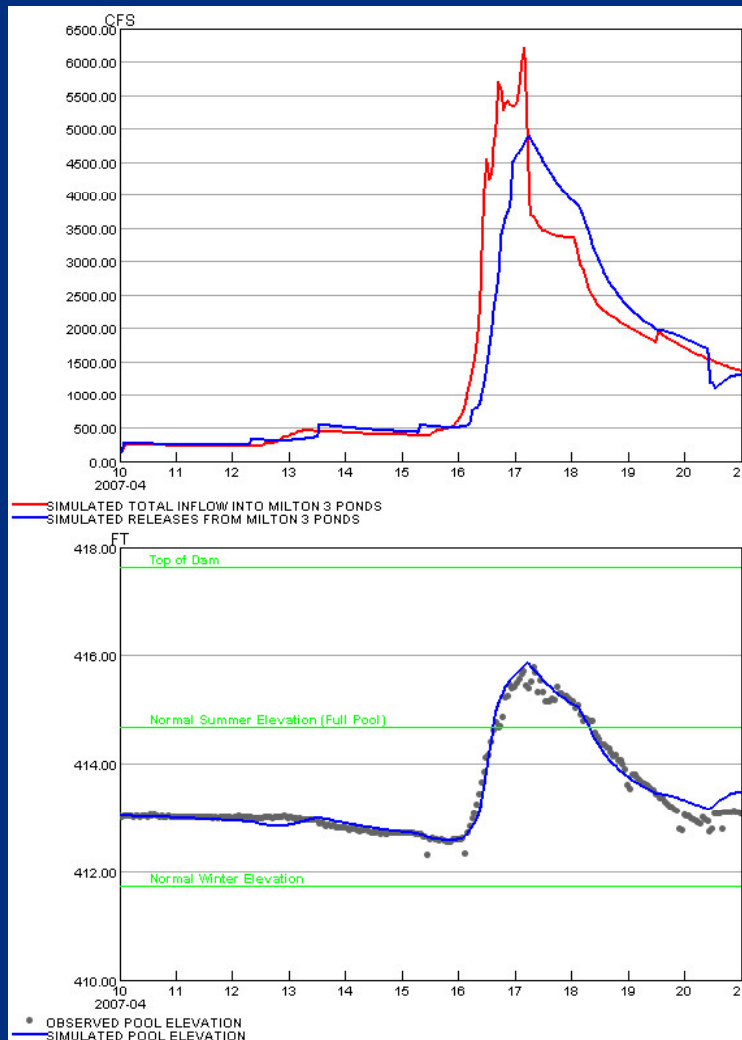
## Milton 3-Ponds Critical Data

- Storage: 15,000 acre-feet
- Drainage area: 108 mi<sup>2</sup>
- 0.42 inches of runoff fills lake



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# Salmon Falls – Milton Three Ponds

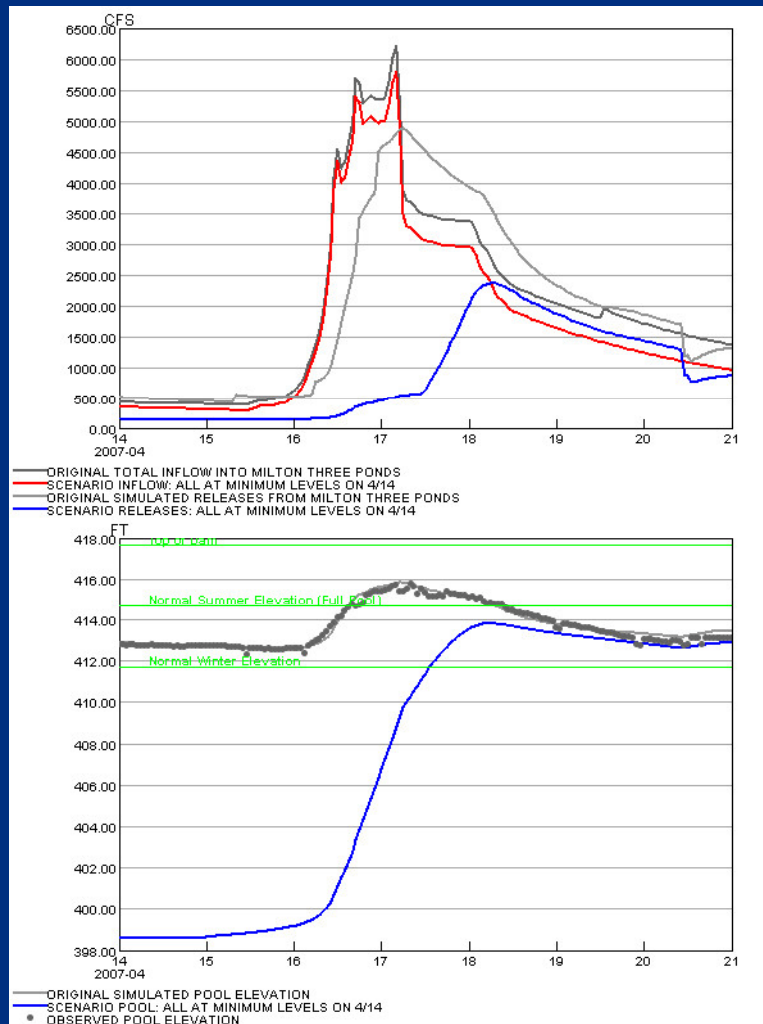


- Operations constrained by downstream dam-failure concerns
- However, does show potential for helping to reduce downstream flooding



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# Salmon Falls – Milton Three Ponds



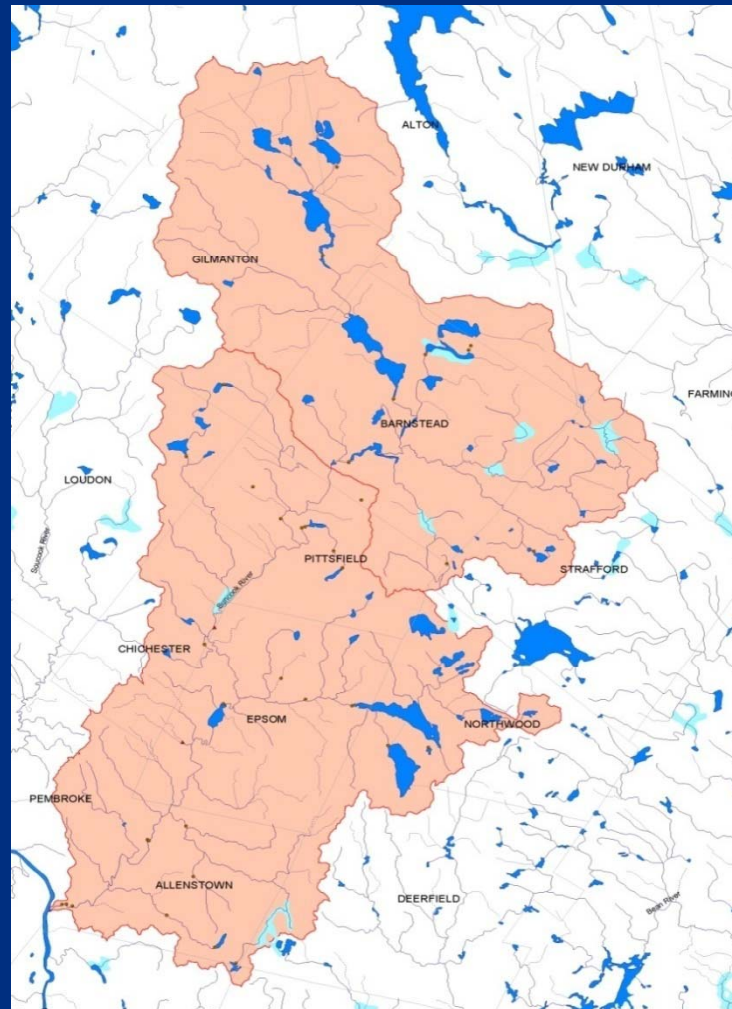
- What if all ponds were empty at beginning of the storm?
- There would be a significant decrease in downstream discharge
- Similar results can be obtained if all gates at Milton are opened way in advance of the storm
- Though this is not a realistic scenario, it does point out that operational improvements may be possible

# Salmon Fall River - Baxter Mills

- The dam was damaged during the May 2006 event when approximately 37 ft of the 103 feet wide 10 ft high spillway failed. An additional nine feet of the spillway was lost during the April 2007 flood.
- Our simulations show that the failure of the spillway likely had inconsequential changes to downstream flow rates.
- Spillway has been rebuilt (lower)



## Suncook River Drainage Area



- Suncook watershed
- Dams
- Gauging Stations



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# Suncook River – Pittsfield Mill Dam



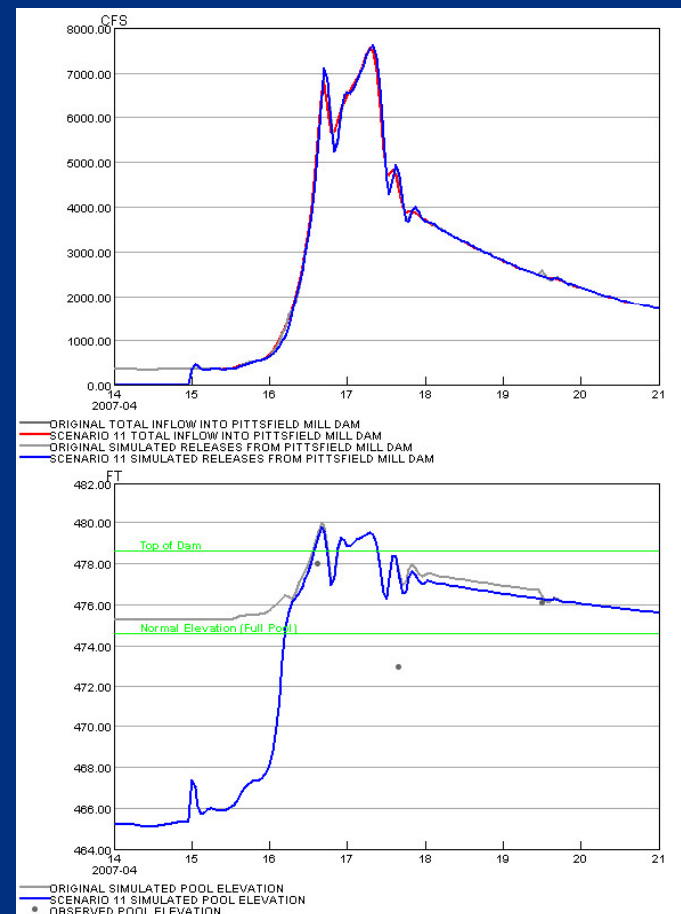
## Pittsfield Mill Dam Critical Data

- Storage: 212 acre-feet
- Drainage area: 131 mi<sup>2</sup>
- 0.01" of runoff to fill lake

# Suncook River – Pittsfield Mill Dam

Concern: Gates  
were stuck shut  
prior to event

Impact: Negligible  
during storm



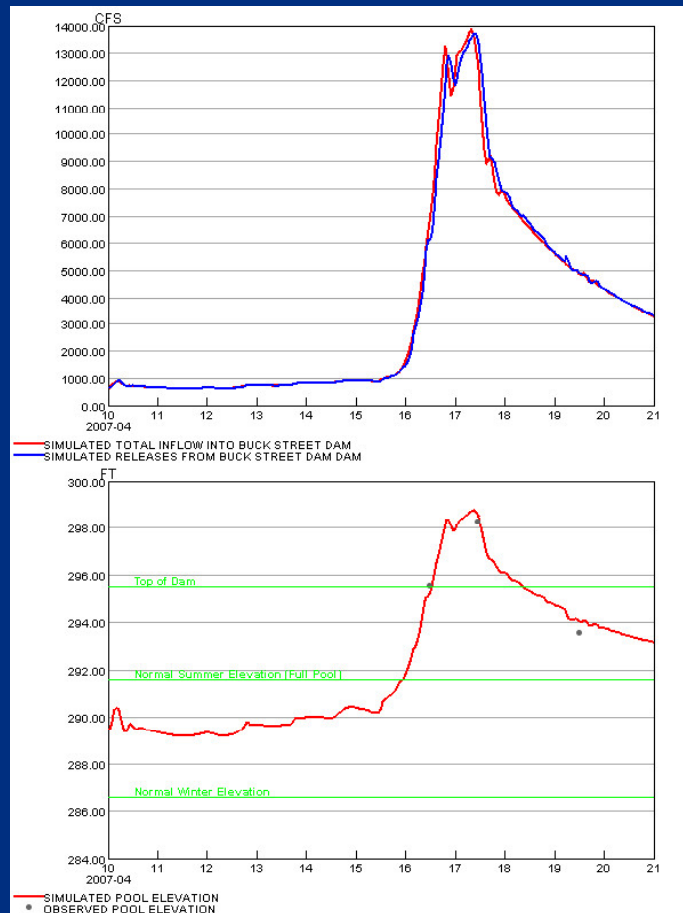
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# Suncook River – Buck Street Dams



- Very limited storage (413 acre-feet) and large drainage area (240 square miles)
- Takes 0.03 inches of runoff to refill

# Suncook River – Buck Street Dams



- Dams were overtopped, despite aggressive operations
- Upstream flooding was reported, probably aggravated by debris buildup
- Dams are being considered for removal

# Suncook River – Webster Mill Dam



- Little storage (165 acre-feet), large drainage area (260 sq. miles)
- Pool rose to top of dam
- All gates open prior to peak of storm
- Gate opening had very temporary effect

# What happens next

- Prepare draft report summarizing what you saw tonight for submittal to IRP
- Review by IRP
- While review is on-going:
  - Evaluate selected dams for potential removal
  - Evaluate certain river crossings for potential improvements
  - Evaluate impact of development on flooding
- Make draft recommendations, submit to IRP
- Incorporate comments, finalize recommendations
- Produce Final Report
- Conduct Final Meeting – on or before June 30<sup>th</sup>



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Questions or Comments?  
You can also send written  
questions to FEMA:  
[david.knowles@dhs.gov](mailto:david.knowles@dhs.gov)

